March 27, 1945. H. M. BASCOM ET AL 2,372,353

TELEPHONE SYSTEM

Filed March 4, 1942 17 Sheets-Sheet 1

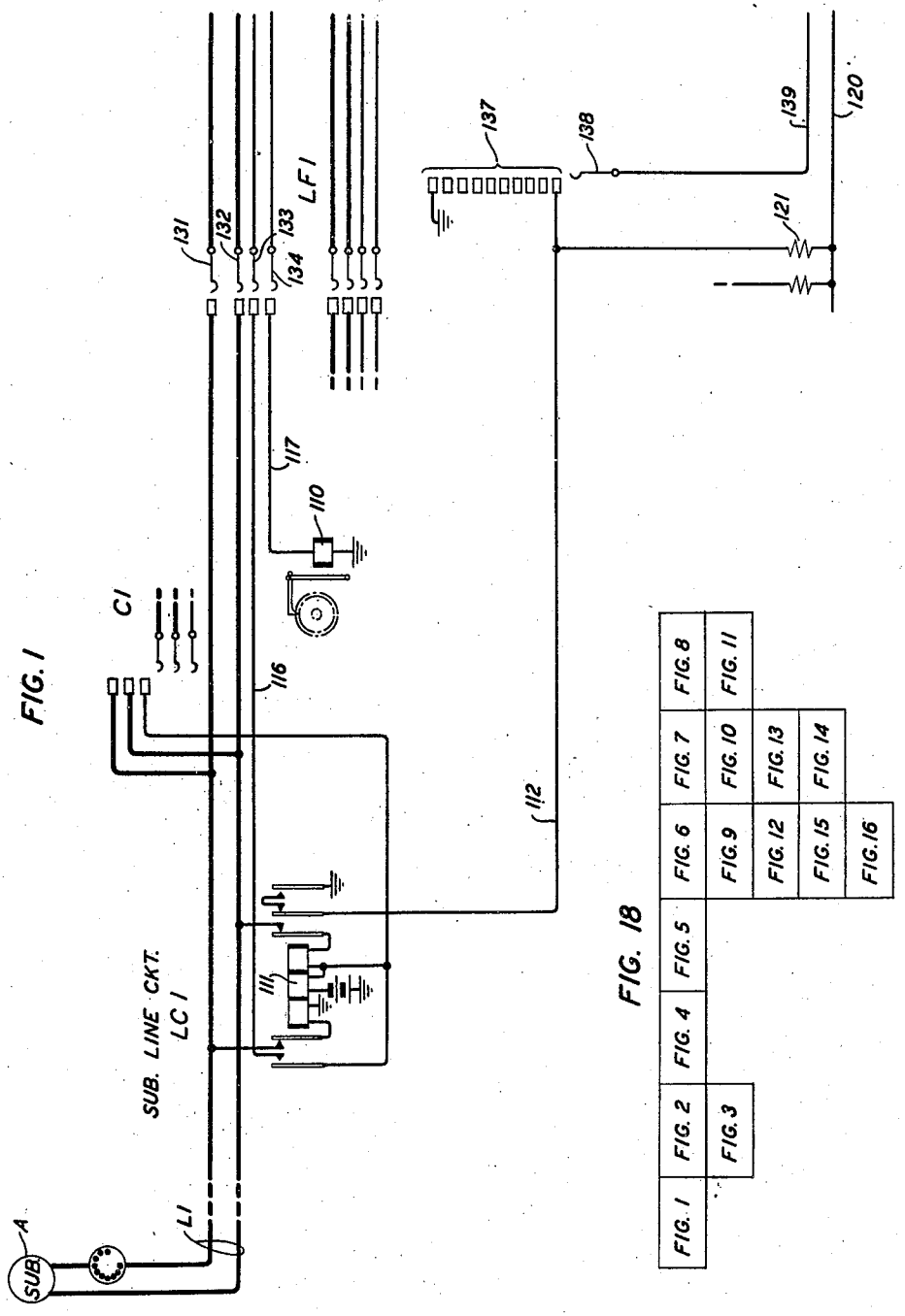

FIG. 1

FIG. 18

					FIG. 8	FIG. 11
				FIG. 7	FIG. 10	FIG. 13	FIG. 14
			FIG. 6	FIG. 9	FIG. 12	FIG. 15	FIG. 16
		FIG. 5				
	FIG. 4					
FIG. 2						
FIG. 3						
FIG. 1						

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TELEPHONE SYSTEM

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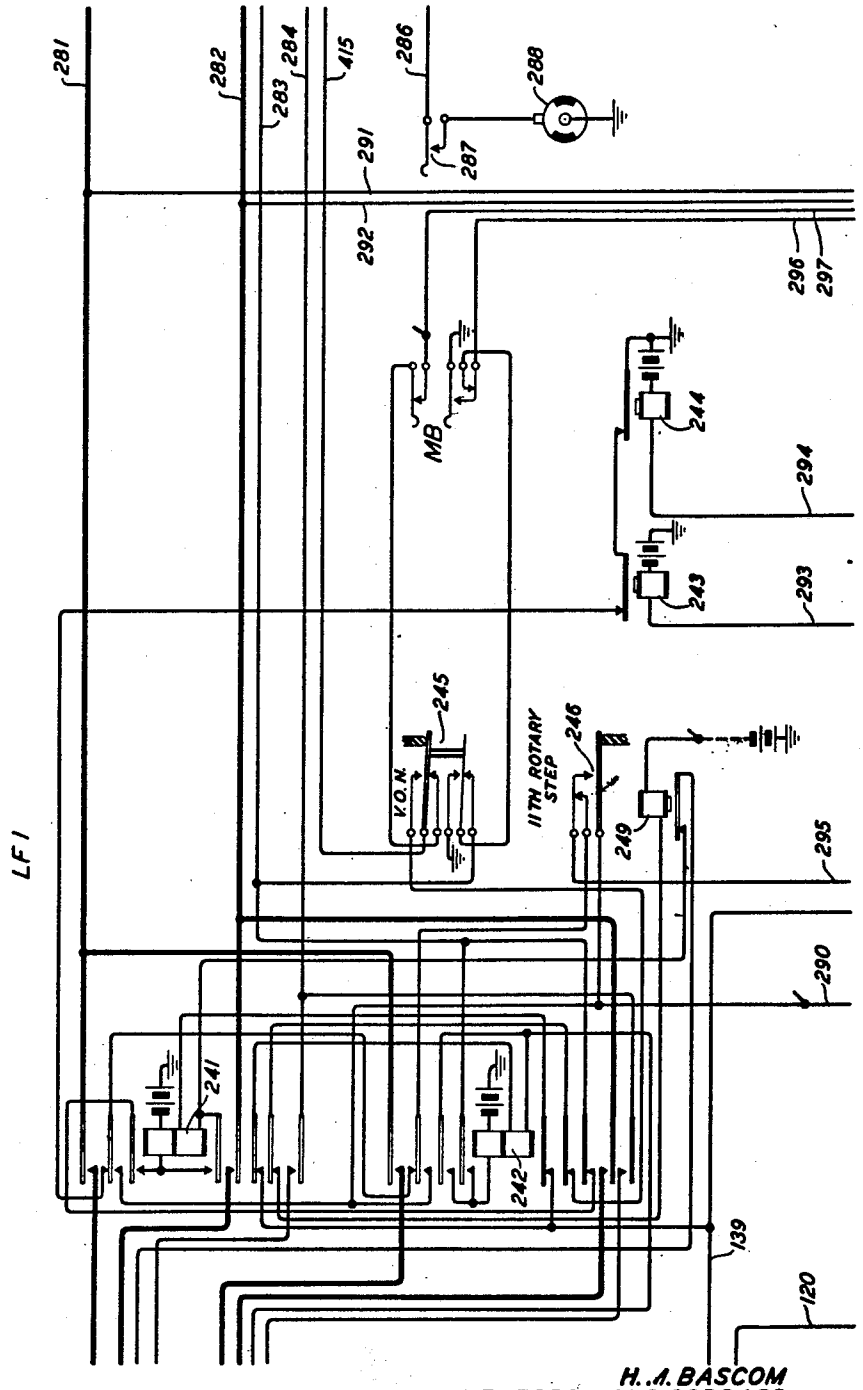

FIG. 2

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Filed March 4, 1942 17 Sheets-Sheet 3

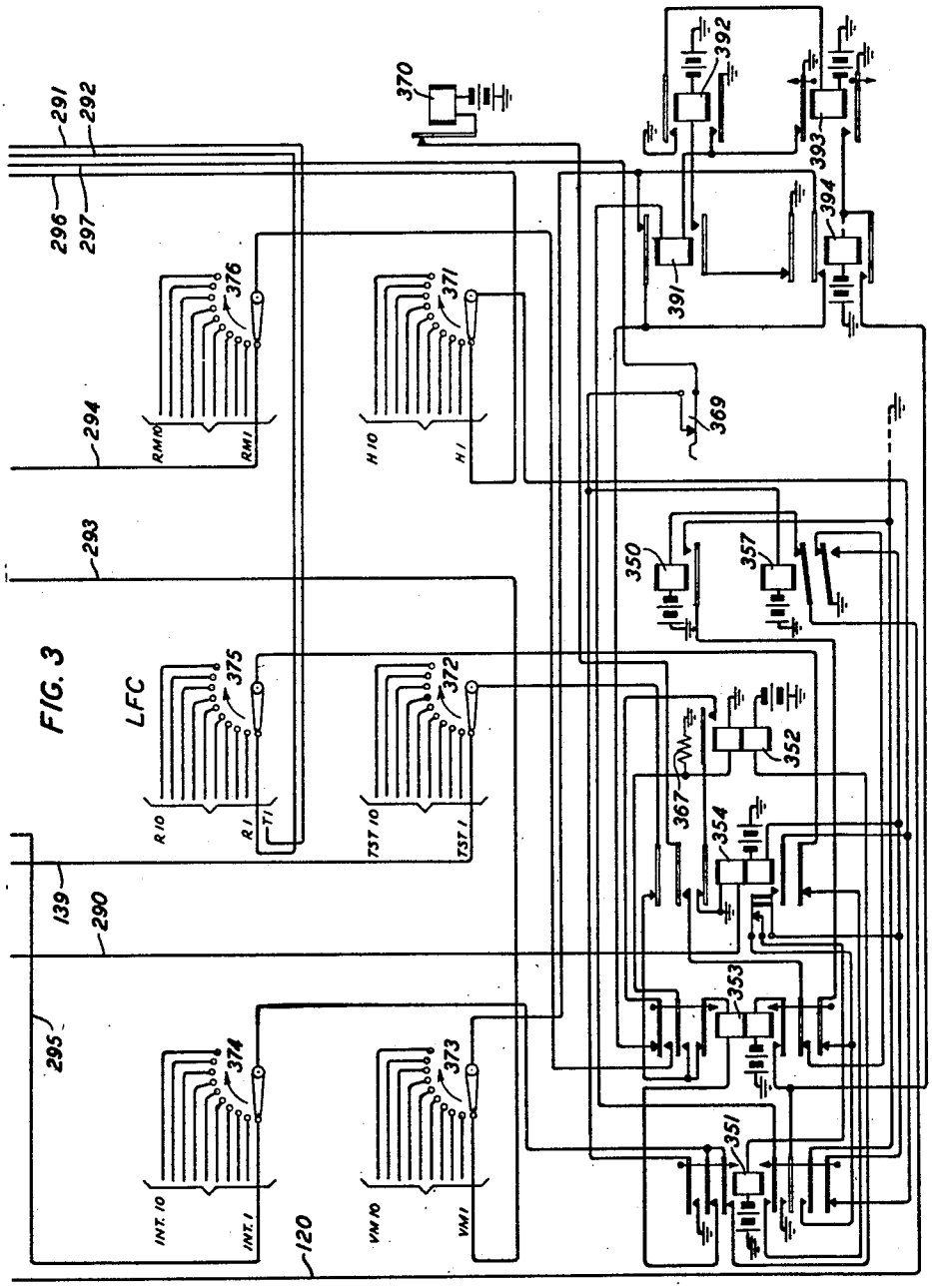

FIG. 3

LFC

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Filed March 4, 1942 17 Sheets-Sheet 4

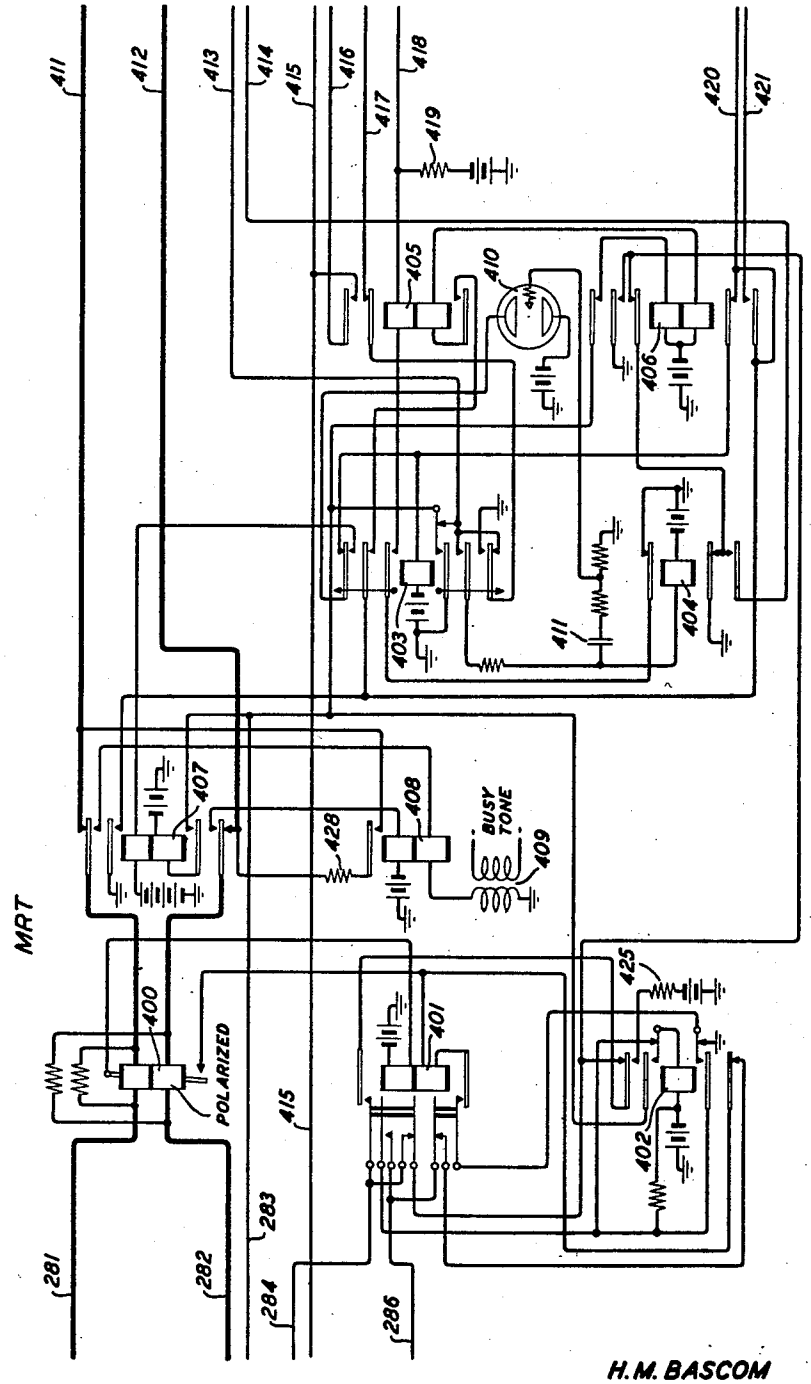

FIG. 4

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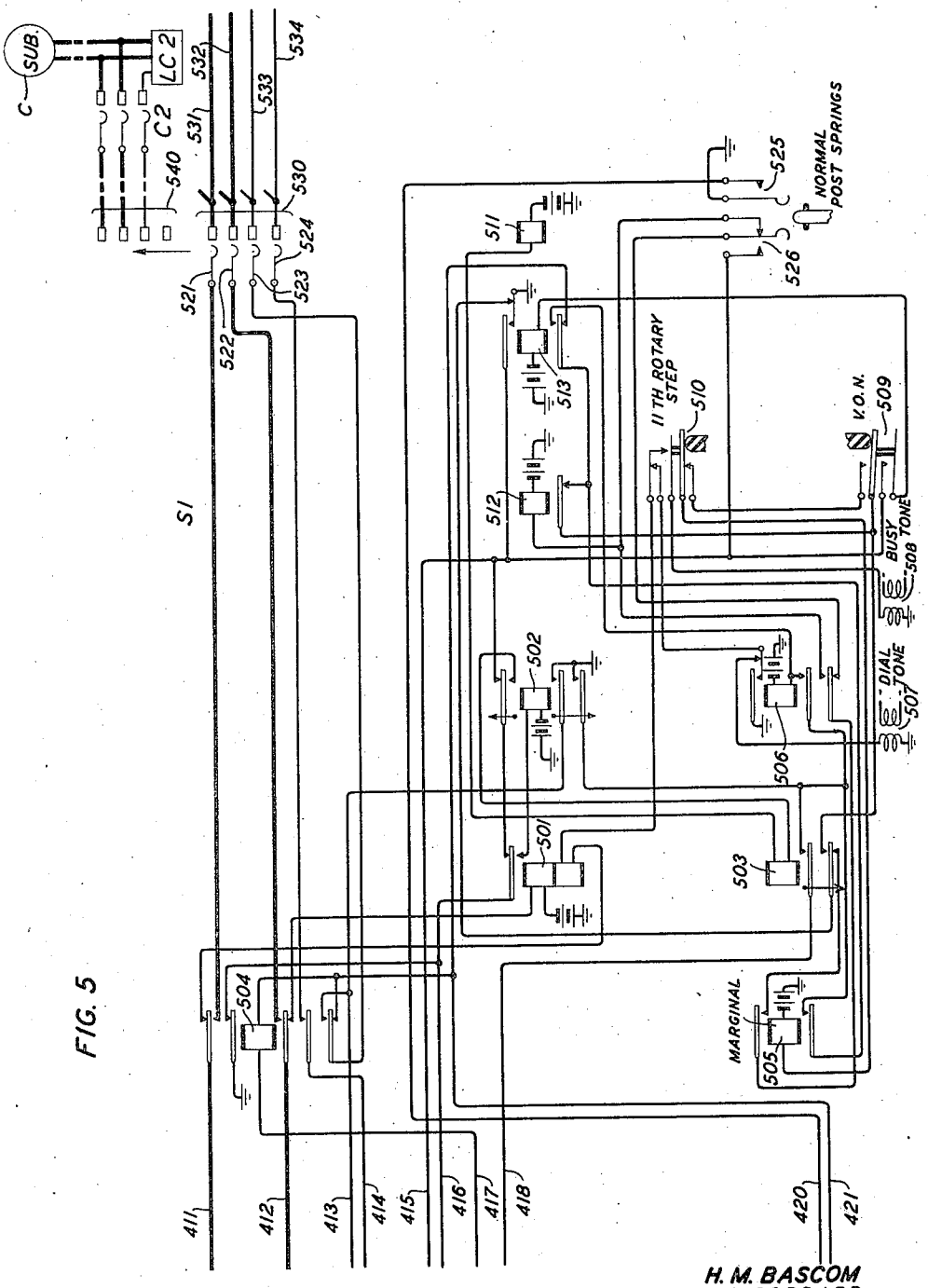

FIG. 5

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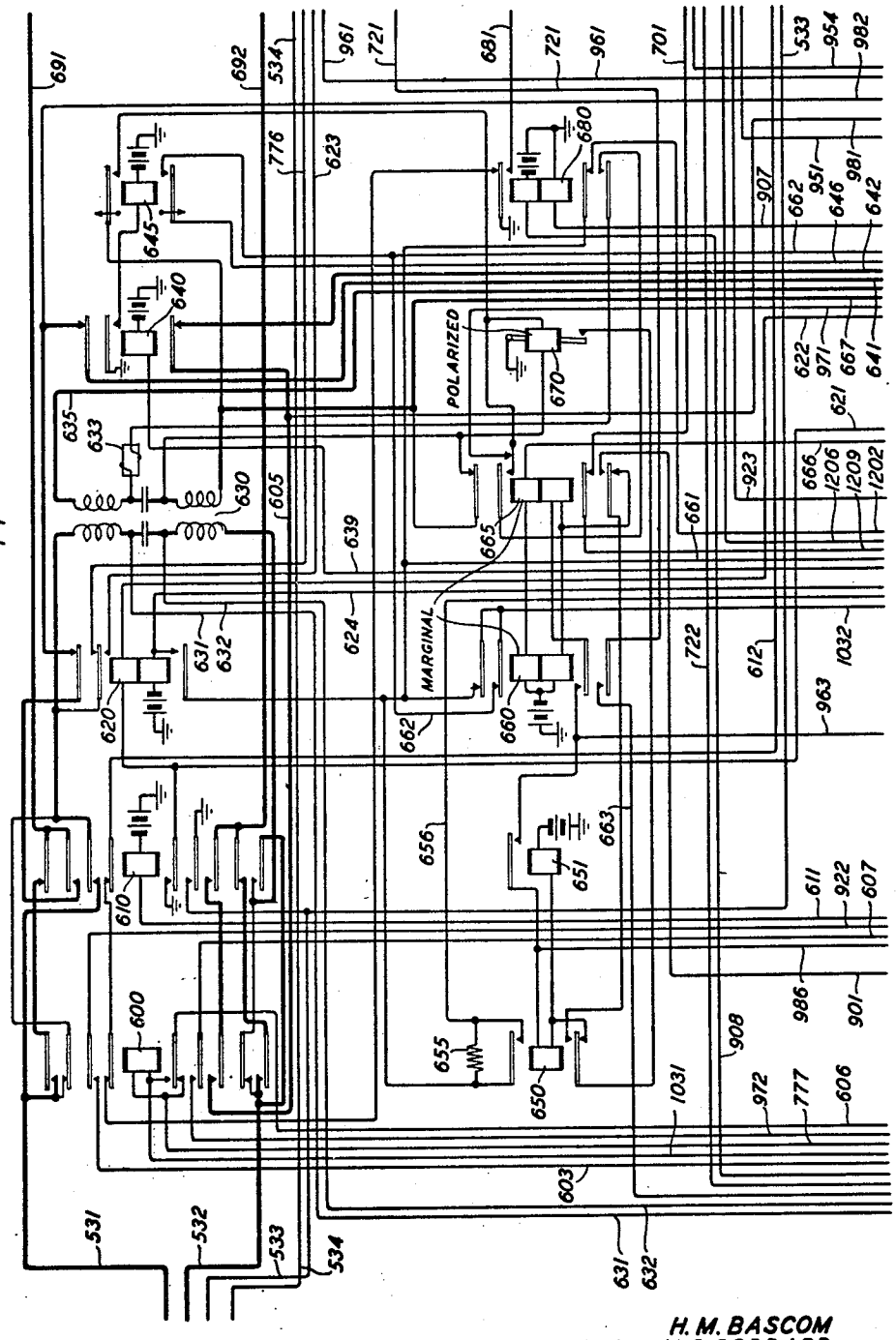

FIG. 6

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TELEPHONE SYSTEM

Filed March 4, 1942 17 Sheets-Sheet 7

FIG. 7

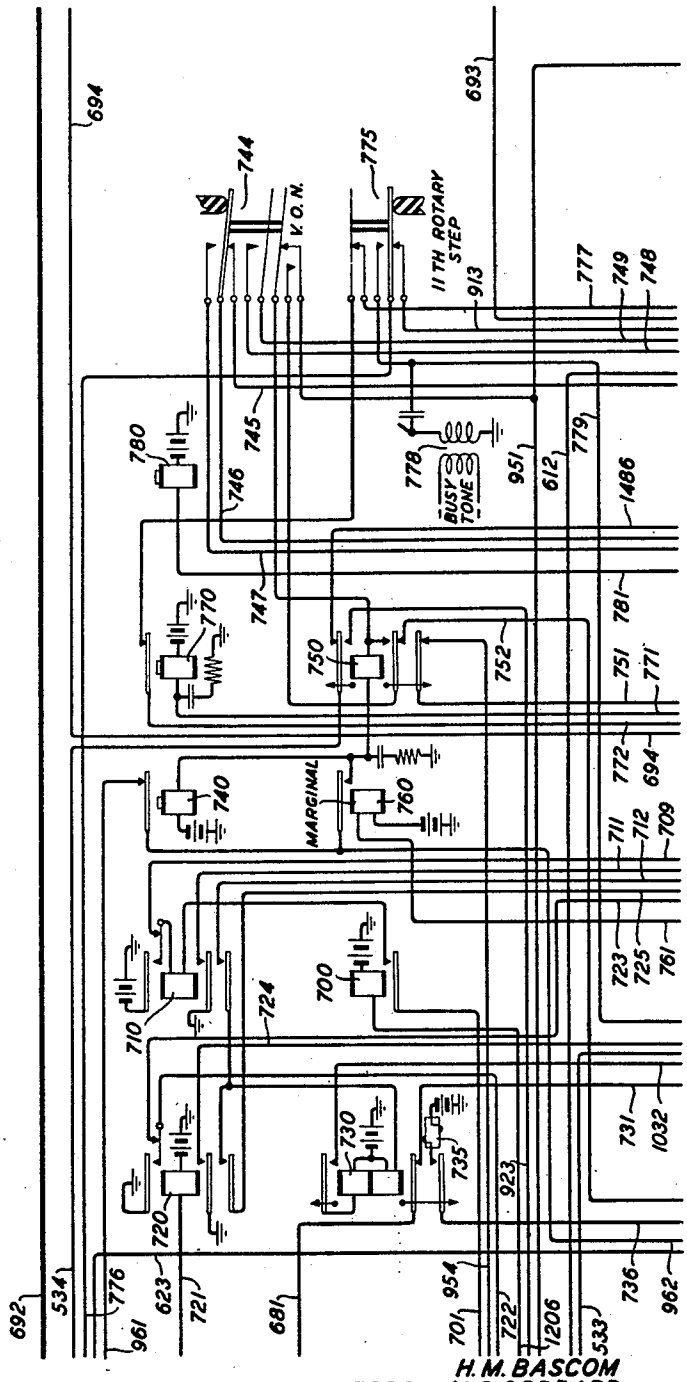

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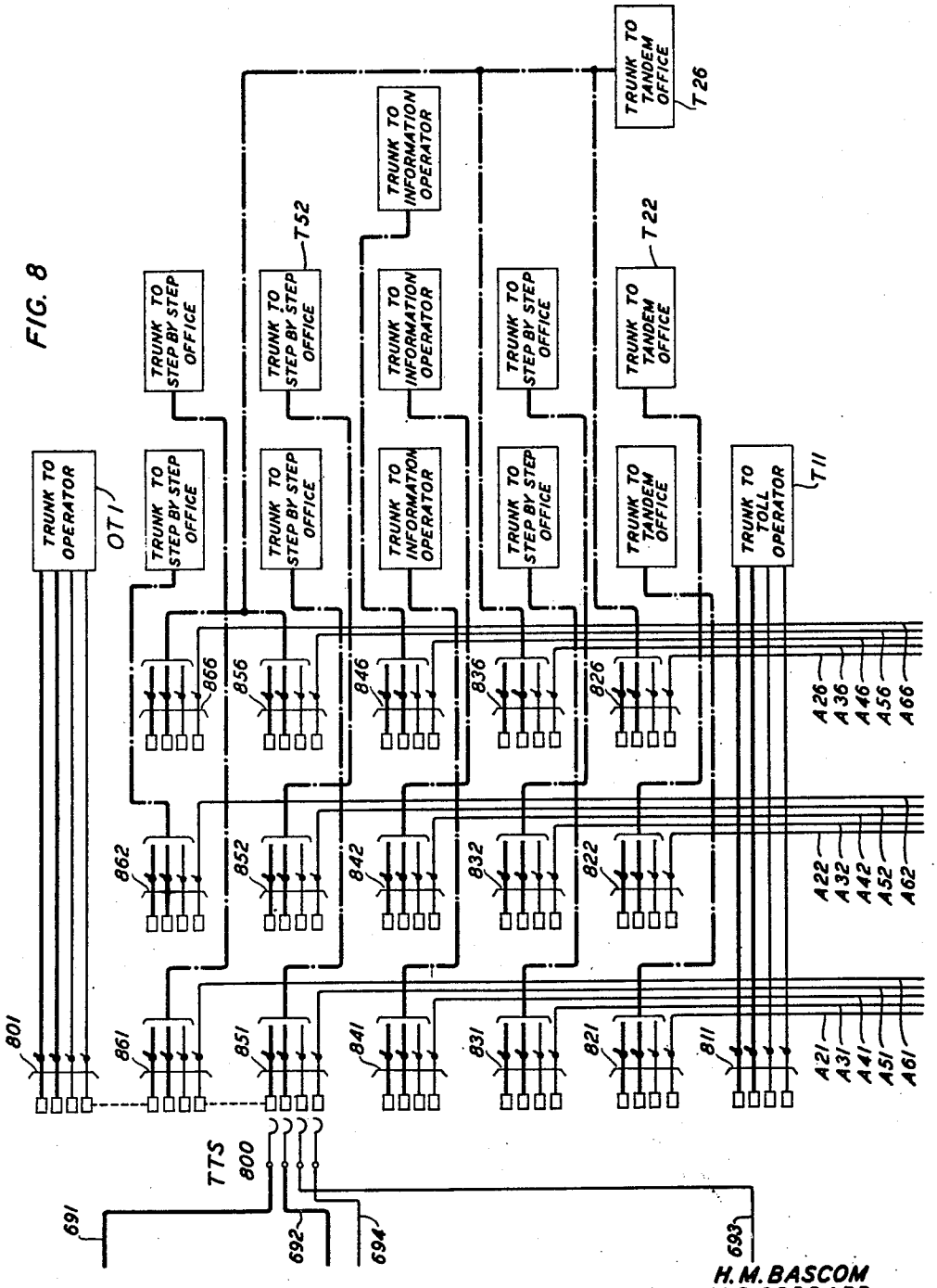
FIG. 8



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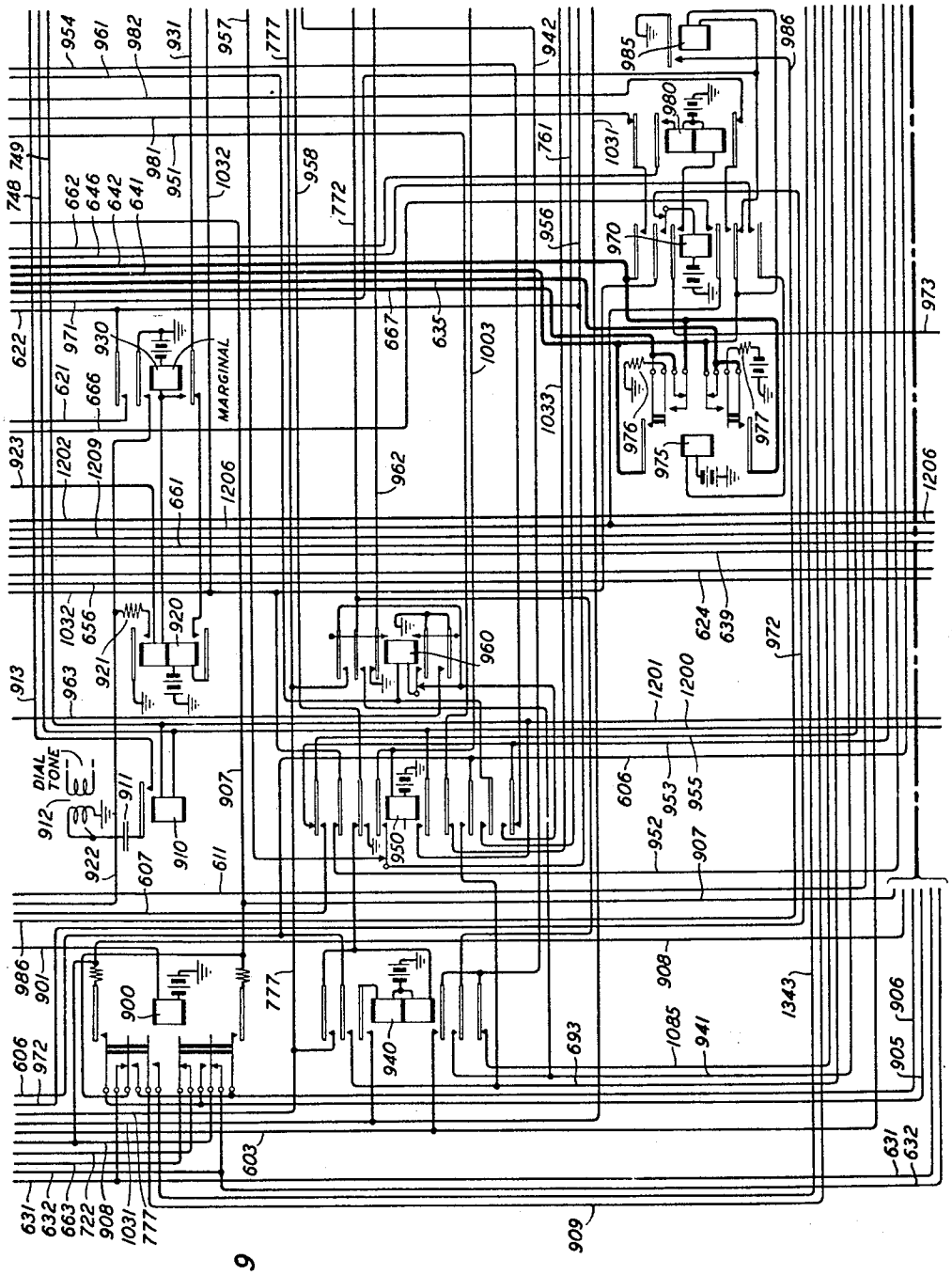

FIG. 9

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FIG. 10

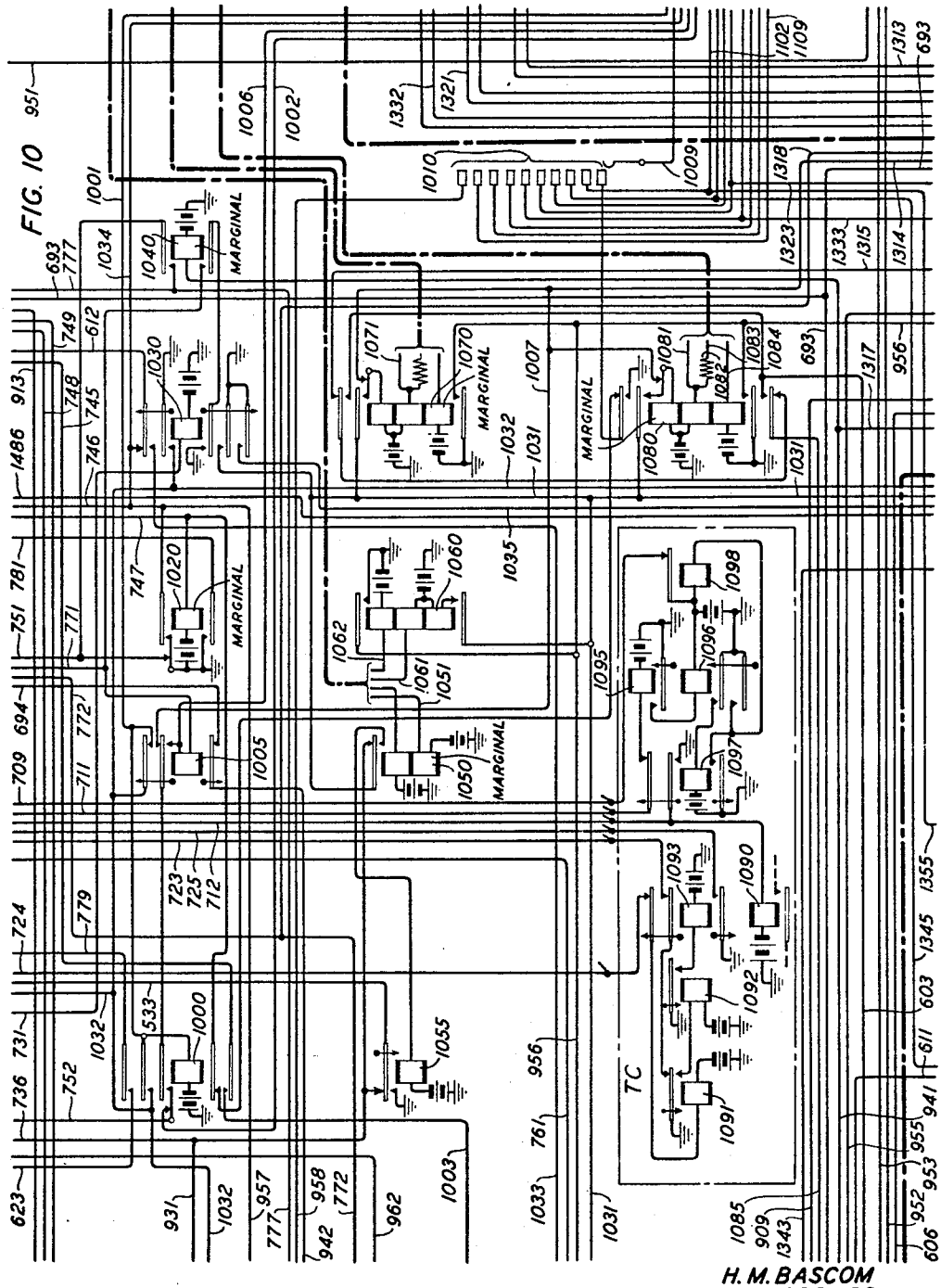

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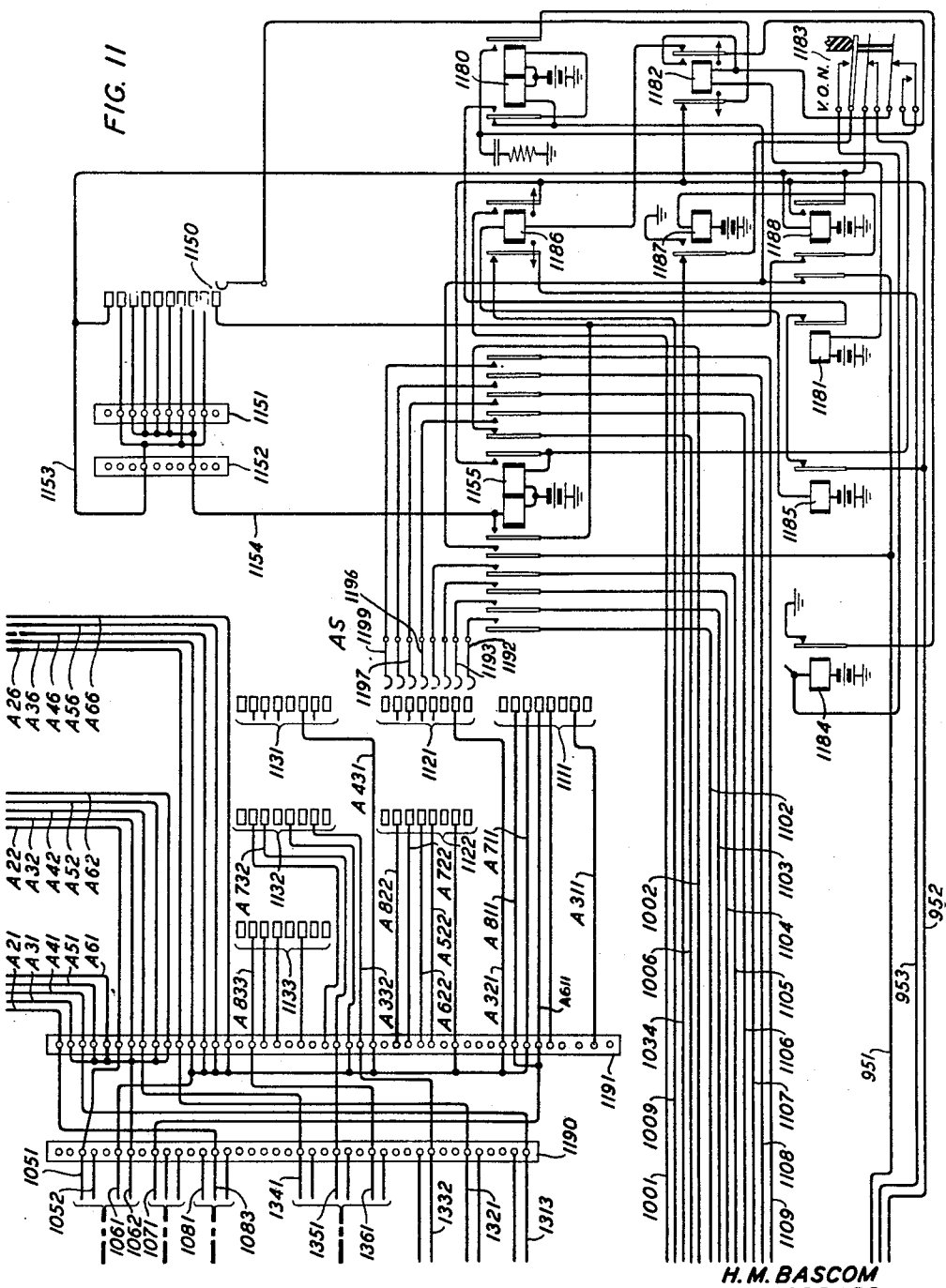
FIG. 11



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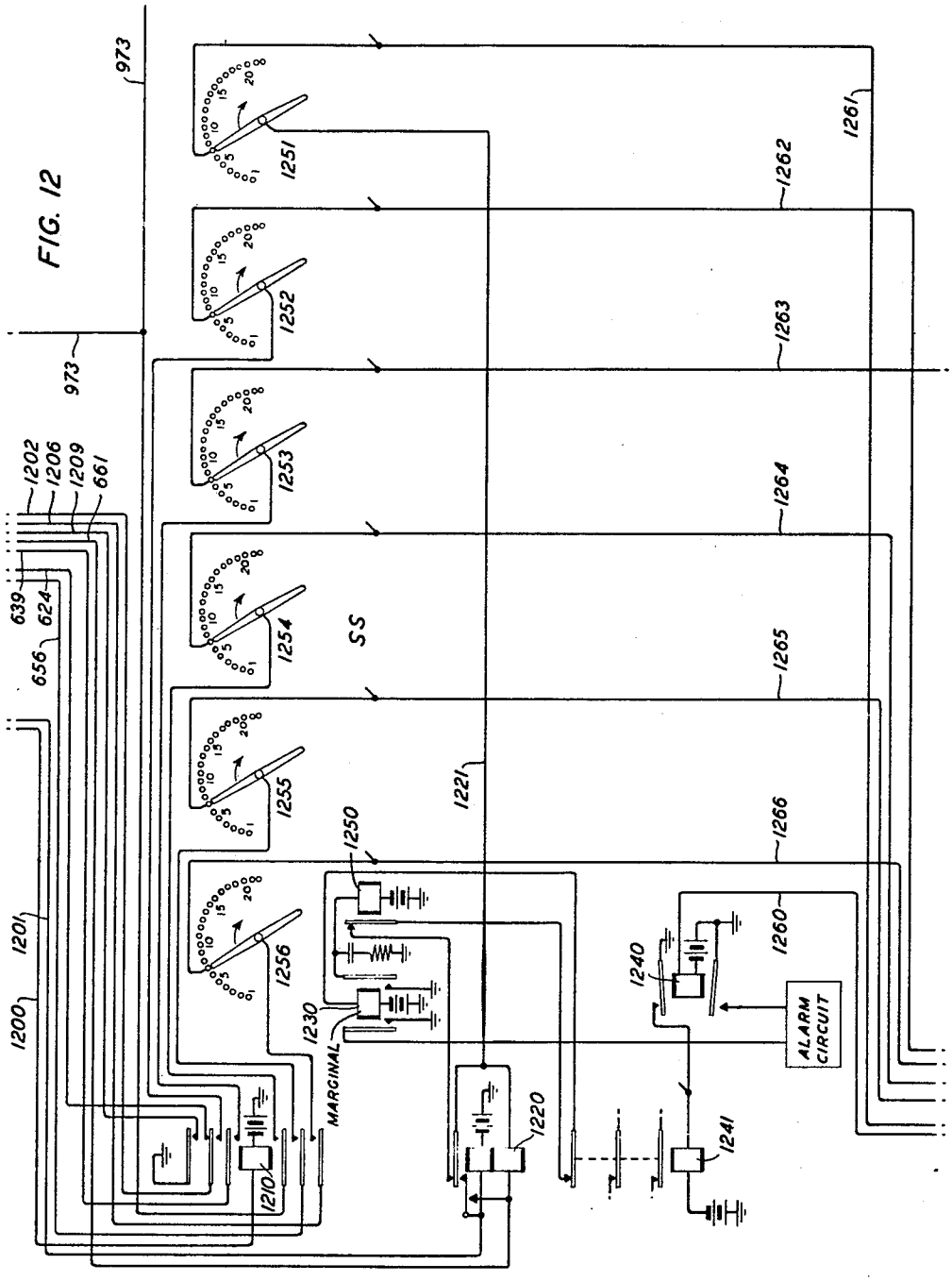
TELEPHONE SYSTEM

Filed March 4, 1942 17 Sheets-Sheet 12

FIG. 12



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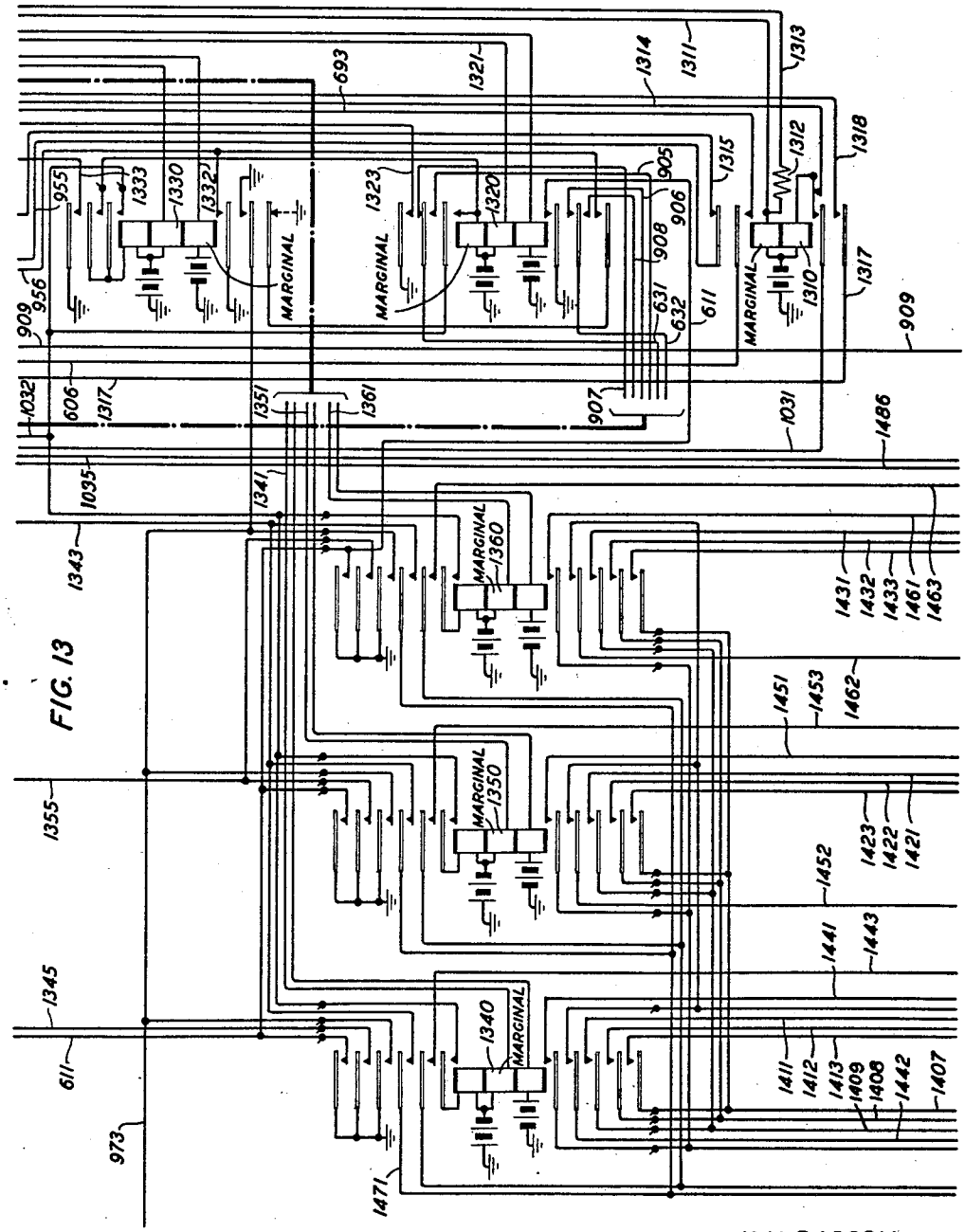

FIG. 13

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TELEPHONE SYSTEM

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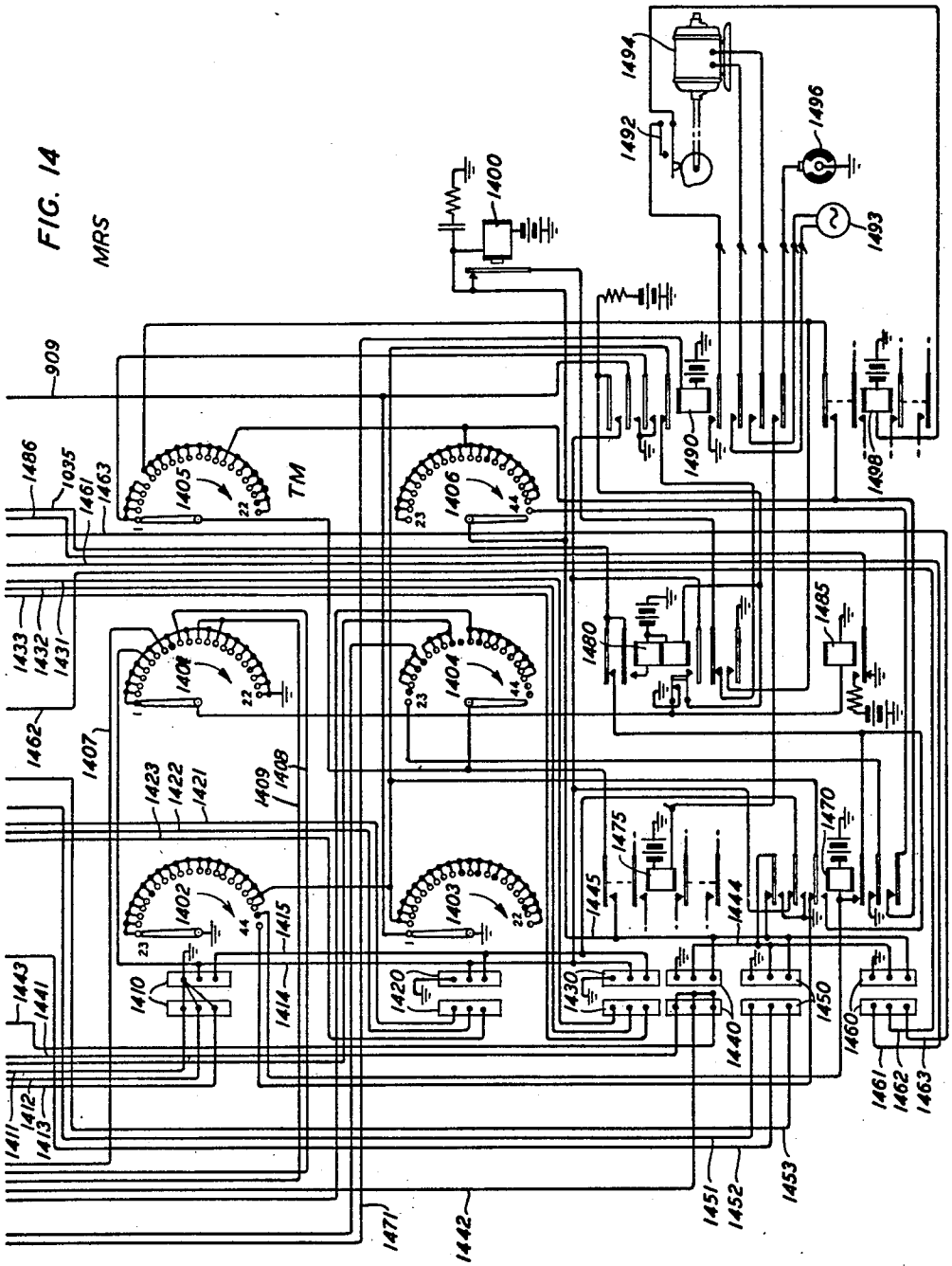
FIG. 14



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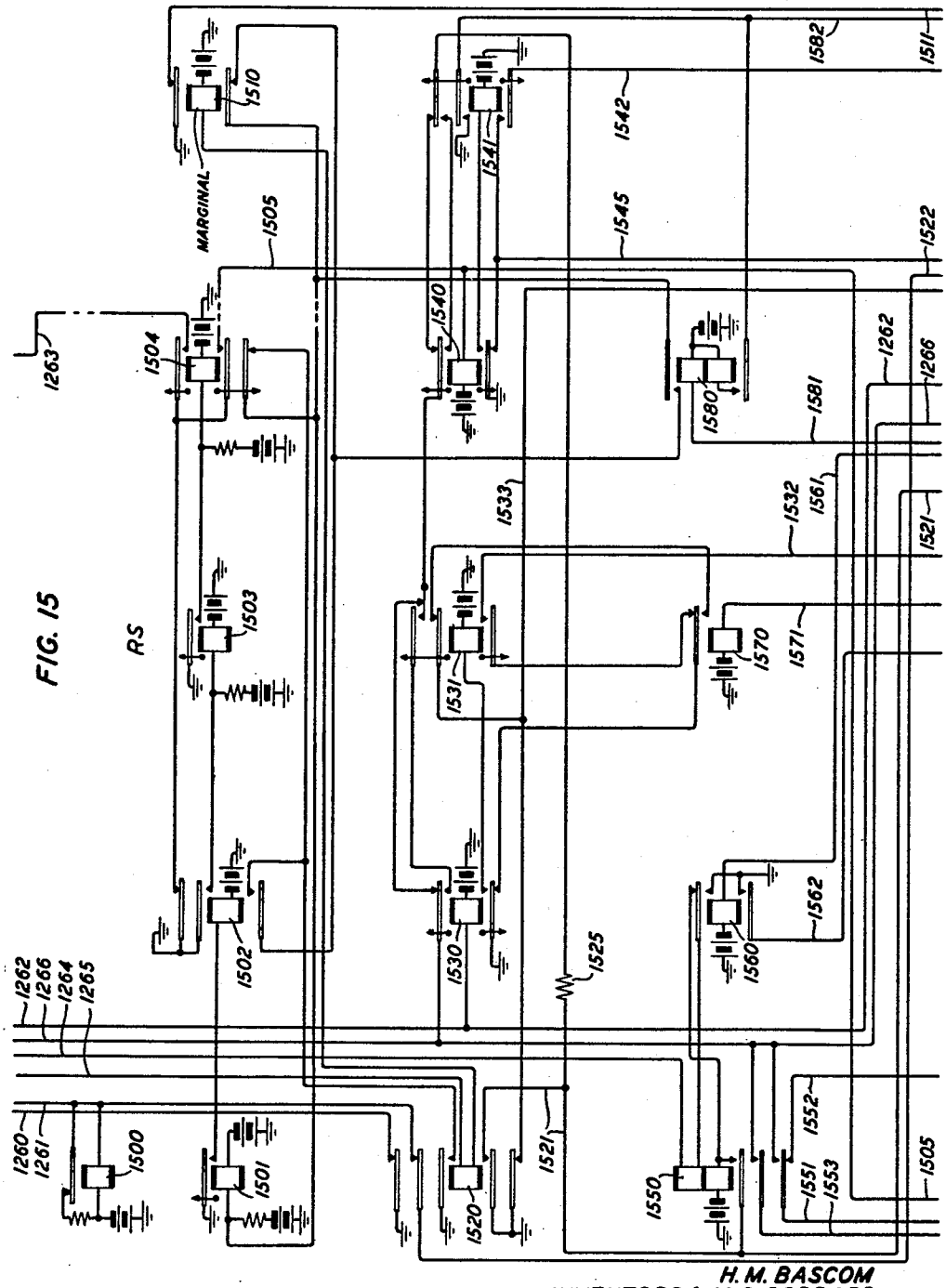

FIG. 15

RS

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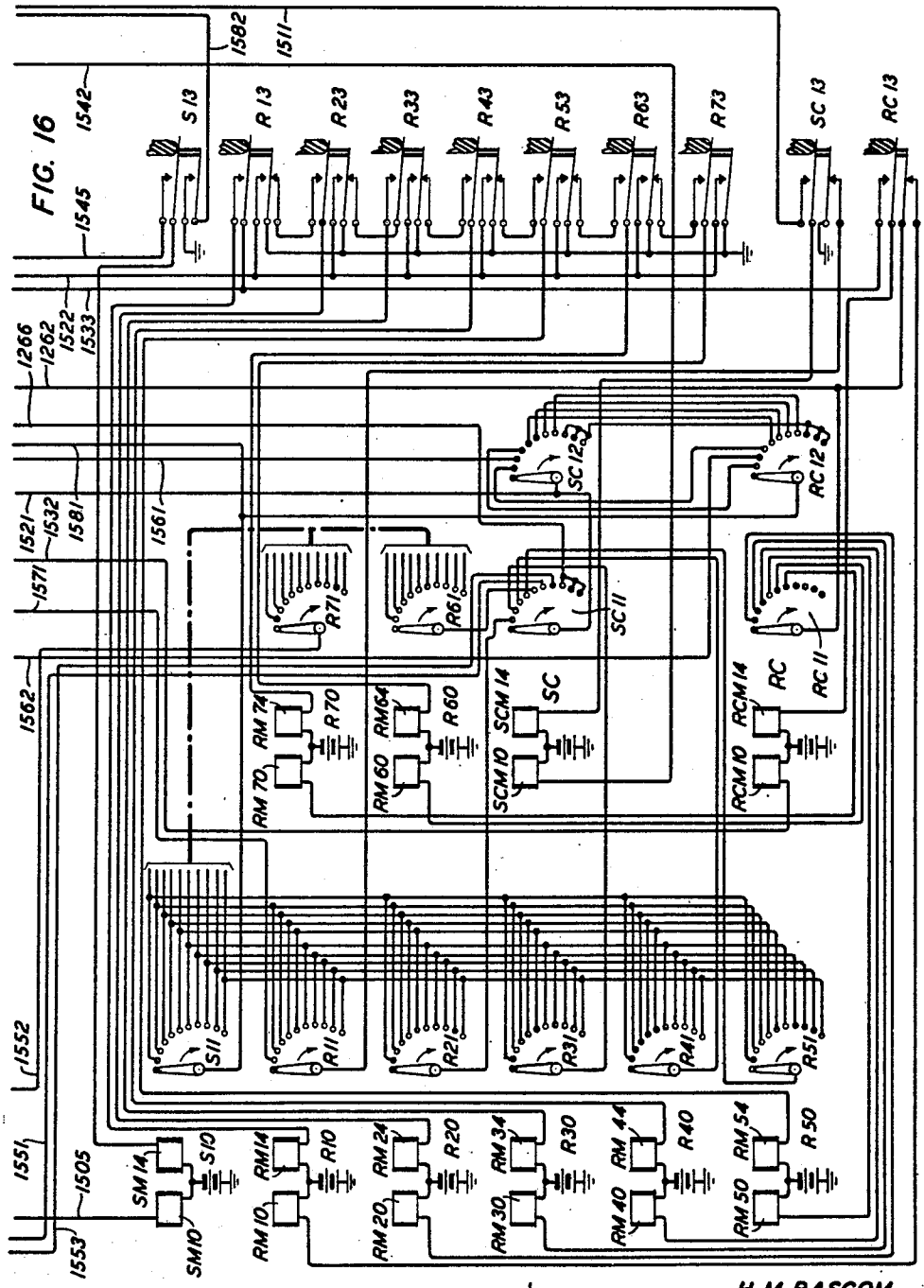
Filed March 4, 1942 17 Sheets-Sheet 16

FIG. 16



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TELEPHONE SYSTEM

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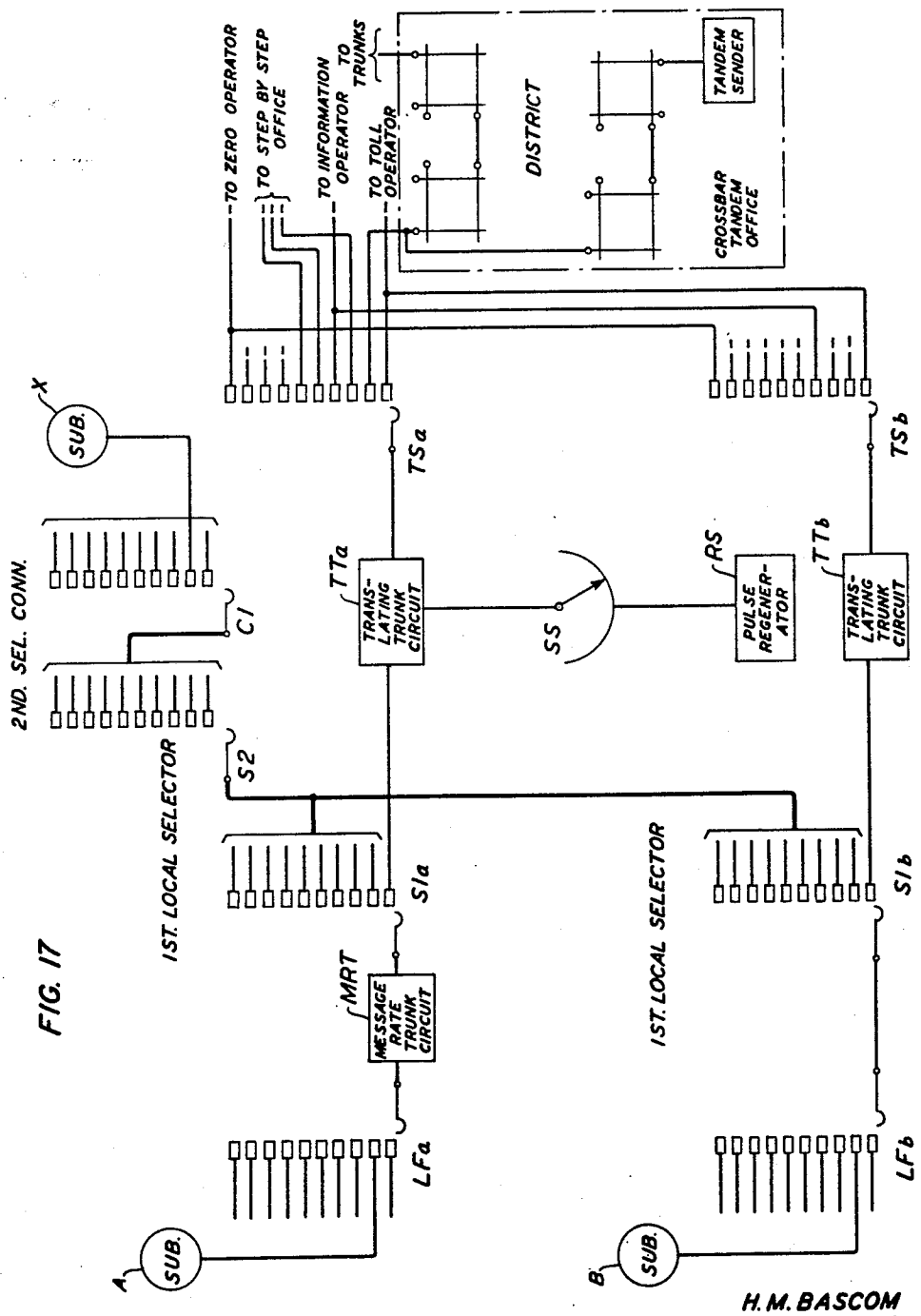

FIG. 17

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Patented Mar. 27, 1945 2,372,353

UNITED STATES PATENT OFFICE

2,372,353

TELEPHONE SYSTEM

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Application March 4, 1942, Serial No. 433,348

14 Claims. (Cl. 179—7.1)

This invention relates to telephone systems and particularly to systems employing impulse controlled switches for completing connections between calling and called subscribers' stations.

Objects of the invention are the improvement and simplification of systems comprising an automatic office adjacent a metropolitan area, the provision of efficient and reliable means in such an office for discriminating between local calls, calls completed over direct interoffice trunks, and calls completed through a tandem office in the metropolitan area, and the provision of means for local and extended service in such an office with further provision for variable charging rates.

Where an automatic telephone office is adjacent a large metropolitan area served by a plurality of telephone offices, calls originating in the office may be local calls, calls to subscribers in adjacent exchanges to which direct trunks are available, or calls to subscribers in offices in the metropolitan area, the last-mentioned calls being routed through a tandem office in the metropolitan area. The number of digits in the directory listed numbers of subscribers in the local, adjacent, and metropolitan offices may vary; and provision must be made for both local and extended area message rate service and for overtime and zone registration.

Applicants' invention is a new, improved and efficient trunking arrangement and equipment for use in an automatic telephone office having having local and extended area message rate subscribers, this office being adjacent a metropolitan area including a tandem office through which calls to subscribers in the metropolitan area may be routed. According to this invention, a calling line in an automatic telephone office is automatically connected by a first group selector switch to an idle translating trunk circuit which is arranged to register the called office code and be restored to normal to effect release of the first group selector on local calls to enable operation of this selector responsive to the first digit following the office code, a part or all of the called office code being registered by a two-motion group selector switch which is restored to normal after the office code has been dialed on all calls except calls to zero operator and which is reoperated on calls other than local calls to select a group of direct interoffice trunks or a group of trunks to a tandem office according to the called office code, the office code and numerical digits being transmitted over a selected interoffice or tandem trunk and the numerical digits alone being transmitted over certain of the direct interoffice trunks.

A feature of the invention is a translating trunk circuit of the above-described character which is adapted to receive both two and three-digit office codes, an auxiliary selector being provided for registering the last two digits of three-digit office codes.

Other features of the invention are the provision of means in a translating trunk of the above-described character for indicating the class of service to which the calling station is entitled on calls to an operator and the provision of means for controlling the operation of a calling subscriber's message register on calls requiring more than one operation of the register.

These and other features of the invention will be better understood by considering a system in which the invention is embodied, one such system being shown schematically in the drawing which forms a part of this specification. The invention is not limited in its application to the system represented in the drawings, but is generally applicable to systems comprising a local automatic office adajacent a metropolitan area.

Referring to the drawings:

Fig. 1 shows a subscriber's station A and line L1, a connector switch C1 and part of a line finder LF1;

Fig. 2 shows the remainder of the line finder LF1;

Fig. 3 shows a line-finder control circuit and allotter switch;

Fig. 4 shows a message register trunk circuit MRT associated with the line finder LF1 of Fig. 2;

Fig. 5 shows a first selector S1 associated with the trunk circuit MRT of Fig. 4;

Figs. 6 to 14, inclusive, show a translating trunk circuit TT comprising a group selector TTS, an auxiliary selector AS, a multiregistration control switch MRS, and a sender selector SS;

Figs. 15 and 16 show a register sender;

Fig. 17 shows the trunking plan of a system comprising the circuits shown in Figs. 1 to 15, inclusive; and

Fig. 18 shows the relative position in which Figs. 1 to 16 are to be placed to form an operative arrangement.

General Description

Referring first to the system and trunking arrangement shown in Fig. 17, subscribers' lines terminate in the banks of line-finder switches. There may be separate groups of line finders for the lines of subscribers restricted to local service and the lines of subscribers entitled to extended area service. The station A represents a group

which is entitled to extended area service and the station B represents a group which is only entitled to local service. A single group of line finders may, however, serve both restricted and extended service subscribers. The line finder LF*a* represents a group which serves lines including message rate lines, the line finder LF*a* being connected by a message rate trunk circuit MRT to a first selector SI*a*. The line finder LF*b* represents a group which serves flat rate lines entitled only to local service, the line finder LF*b* being connected directly to a first selector SI*b* The selectors SI*a* and SI*b* have access to connector switches for completing local calls and have access on the first level to discriminating or translating trunk circuits TT*a* and TT*b* respectively. Upon connection of a calling line to a first selector, the selector is automatically operated to hunt for an idle discriminating trunk circuit TT*a* or TT*b* as the case may be. The trunk circuit TT*a* includes a trunk selector TS*a* and the trunk circuit TT*b* includes a trunk selector TS*b*, which selectors have access in common on the tenth level to trunks to zero operator, on level 1 to trunks to toll operator, and on level 4 to trunks to information operator. The selector TS*a* also has access on the second level to trunks to a crossbar tandem office in an adjacent metropolitan area and on the third, fifth and sixth levels to trunks to other step-by-step offices. The trunk circuit TT*a* includes a switch SS for selecting an idle register sender RS for use on calls other than local calls or calls to an operator. If desired, each translating trunk circuit may be provided with an individual register sender. The trunk circuit TT*b* does not include a register sender or have access to a group of such senders since the associated lines are not entitled to extended service. Each of the trunk circuits TT*a* and TT*b* are arranged to respond to the office code digits dialed by a connected calling subscriber, the associated trunk selector responding to the first digit dialed. If the first digit is "0," the brushes of the selector are selectively stepped up to the tenth level and automatically advanced to find an idle trunk to an operator's position. While not shown in Fig. 17 an auxiliary switch may be provided in each of the trunk circuits TT*a* and TT*b* in case the code of any called office includes more than two digits. In any event, two digit codes are registered by selective vertical and rotary movement of selectors TS*a* and TS*b*.

If the called office code, as registered in a discriminating trunk circuit TT*a* or TT*b* is the local office code, the discriminating trunk circuit is restored to normal; and the first selector, by which the discriminating trunk circuit was selected, is also restored to normal so as to be ready for operation in response to the first digit dialed after the office code. While the bank of selectors SI*a* and SI*b* are shown as connecting directly to connector switches, intermediate selectors may be provided if the number of lines in the local office requires an additional stage of selection. The desired connection is completed by the operation of a connector under the control of the calling subscriber's dial in the usual manner. If the calling subscriber connected to a trunk circuit TT*a* or TT*b* dials a special service code such as 211, 411, etc., the associated selector TS*a* or TS*b* will be restored to normal and automatically reoperated to select a level in which the terminals are connected to trunks to an operator. The trunk circuits MRT and TT*a* and switches SI*a* and TS*a* are provided with a fourth conductor through which a class of service signal is transmitted to the answering operator. If the calling subscriber dials the code of an adjacent local office to which direct trunks are available in the banks of selectors TS*a*, the selector TS*a* is restored to normal and reoperated automatically to select the proper level and an idle trunk therein. The third, fifth and sixth levels of selectors TS*a* are represented in Fig. 17 as being levels in which the terminals are connected to direct interoffice trunks.

If the calling subscriber dials the code of an office which is reached through the metropolitan tandem office, the trunk selector TS*a* is restored to normal and automatically reoperated to select an idle trunk in the level in which the terminals are connected to trunks to the tandem office. The sender selector SS of the discriminating trunk circuit TT*a* is a preselector which is advanced to an idle register sender RS wherever the register sender to which the trunk circuit is then connected becomes busy; and all digits of the called subscriber's number are registered in the selected register sender on calls, other than local calls and calls to an operator. If the call is routed over a direct trunk, the office code digit may or may not be transmitted, in addition to numerical digits, by the register sender to the called office. On a call routed through the tandem office, the register sender transmits both the office code and the numerical code over the selected trunk.

The subscribers' stations A, B and X are of the usual type provided in common battery automatic offices, each station being provided with a dial or other impulse sending device for controlling the establishment of desired connections. The line finder, selector and connector switches are of the two-motion step-by-step type. Reference may be had to "Automatic Telephony" by Smith and Campbell, 2nd edition, pages 53 to 65, inclusive, for a description of the structure of such switches and their operation as selectors and connectors. Reference may be had to the patent to T. L. Dimond 2,210,068, August 6, 1940, for a detailed description of a two-motion line finder and and associated line-finder control and allotter circuit.

The circuits shown in Figs. 1 to 16, inclusive, conform to the trunking plan shown in Fig. 17 except that the tandem trunks which are connected to the last five sets of terminals in the second level of the bank of selectors TTS are also connected to corresponding sets of terminals in the third, fifth and sixth levels. The operation of the system represented in Figs. 1 to 16, inclusive, will be described for various types of call.

Detailed Description

Connection of calling line to translating trunk circuit

Assuming that a call is initiated at station A, a circuit is closed for operating relay 111 of line circuit LC1, this circuit being traced from battery through the middle and right windings and inner right back contact of relay 111, lower conductor of line L1, through the telephone and dial at station A, back over the other conductor of line L1, through the left back contact and left winding of relay 111 to ground. Relay 111 is partially actuated to close its front contacts without opening its back contacts, thereby connecting the middle winding of relay 111 to conductor 116, connecting ground through conductor 112 to a terminal of commutator 137 to identify the level of the banks

of the line finders in which is located the set of terminals to which the line L1 is connected, and connecting ground through resistor 121, conductor 120, and a front contact of the normally operated transfer relay 357 of the line-finder control circuit LFC to the winding of start relay 350. Relay 350 operates, closing a circuit for operating relay 351, this circuit being traced from battery through the winding of relay 351, inner lower back contact of relay 354, a lower back contact of relay 353, front contact of relay 350, to ground. Assume that the brushes of the allotter switch are in engagement with the terminals to which the line finder LF1 is connected and that this finder is idle at the time relay 350 operates. Relay 351 locks through its outer lower front contact, under the control of relay 354 and closes a circuit for operating line relay 501 of selector S1 and relay 391 of the line-finder allotter circuit LFC. The circuit for operating relays 501 and 391 is traced from battery through the upper winding of relay 501, inner lower back contact of relay 504, conductor 412 of trunk circuit MRT, lower back contact of relay 407, lower winding of relay 400, conductor 282, conductor 292, terminal and brush of bank 375 of the line-finder allotter LFC, a lower back contact of relay 354, inner lower front contact of relay 351, winding of relay 391, to ground at a back contact of relay 393. Relay 501 closes a circuit for operating slow-to-release relay 502; and relay 502 connects ground to conductor 413 of trunk circuit MRT to hold the line-finder circuit LF1 after it has established connection with the calling line as hereinafter described. The operation of relay 391 closes a circuit for operating relay 392 and prevents the operation of the vertical stepping magnet 243 of the allotted line finder LF1 until the selector S1 has been operated to select the terminals of a translating trunk in the first level of its bank, as hereinafter described. Relay 392 closes a circuit for operating relay 393 and connects ground to the winding of relay 391 to maintain the operation of relay 391 after relay 393 has operated. Relay 393 closes a circuit for operating relay 394. Relay 394 locks through its lower front contact under control of relay 351; and causes the release of relay 392, thereby opening the circuit through the winding of relay 391 and the upper winding of relay 501 to cause the release of these relays. The release of relay 391 causes the release of relay 392; the release of relay 392 causes the release of relay 393; and relay 393 reconnects ground to the winding of relay 391 to effect the reoperation of relays 391 and 501. Relay 393 is slow in releasing to insure the release of relays 391 and 501. Thus the operation and release of relays 392 and 393 is effective to simulate the transmission of one dial pulse to the line relay 501 to operate selector S1, as hereinafter described. The aforementioned operation of relay 351 of allotter circuit LFC also closes a circuit for operating the stepping relay 352, this circuit being traced from battery through the lower winding of relay 352, inner upper front contact of relay 351, brush and terminal of bank 374 of the allotter switch, conductor 295, back contact of the eleventh rotary step springs 246, upper back contacts of relays 242 and 241, through the back contacts of vertical stepping magnet 243 and rotary stepping magnet 244 of the line finder LF1, to ground. The operation of relay 352 closes a circuit from ground at the inner upper back contact of relay 354, through the front contact of relay 352, uppermost back contact of relay 353, through the upper back contact of relay 391 or through the upper front contact of relay 394, brush and terminal of bank 373 of the allotter switch, conductor 293, to the winding of the vertical stepping magnet 243 of line finder LF1. Magnet 243 operates, stepping the two sets of brushes of line finder LF1 up to the first level of the terminal bank. The vertical off-normal springs 245 are actuated when the shaft on which the brushes are mounted moves out of normal position. The operation of magnet 243 opens the operating circuit of relay 352; but, if the calling line is connected to terminals in the first level of the line-finder bank, relay 352 is held operated to prevent the reoperation of magnet 243. The circuit for holding relay 352 operated is traced from battery through the lower winding of relay 352, inner and middle upper front contacts of relay 351, upper winding and inner upper back contact of relay 353, uppermost back contact of relay 354, brush and terminal of bank 372 of the allotter switch, conductor 139, commutator brush 138 and first segment of commutator 137 of line finder LF1, through conductor 112 to ground at the right front contact of relay 111. Relay 353 is partially operated by the energization of its upper winding in this circuit so as to close its lowermost contact and thereby operatively energize its lower locking winding under control of relay 351. The complete operation of relay 353, due to the energization of its locking winding, opens the circuit through its upper winding, opens the operating circuit of stepping magnet 243 and closes a circuit for operating the rotary stepping magnet 244. Relay 353 is slow in operating so that the brushes of the line finder will stop vibrating before the circuit is closed for operating the rotary stepping magnet. The circuit for operating the rotary stepping magnet 244 is traced from battery through its winding, conductor 294, terminal and brush of bank 376 of the allotter switch, uppermost front contact of relay 353, front contact of relay 352, to ground at a back contact of relay 354. The operation of magnet 244 steps the brushes of the line-finder switch into engagement with the first set of terminals in the level to which the brushes were advanced by the operation of magnet 243. The operation of the magnet 244 opens the circuit through the lower winding of relay 352; and relay 352 releases unless a calling line is connected to the terminals engaged by one of the sets of brushes of the line finder. If neither of the two lines connected to the terminals engaged by the brushes is a calling line awaiting connection to a first selector, relay 352 releases when the circuit through its lower winding is opened by the operation of magnet 244. The release of relay 352 causes the release of stepping magnet 244; and the release of stepping magnet 244 again closes the operating circuit for relay 352. Relay 352 and stepping magnet 244 are thus alternately operated and released to advance the brushes of the line finder, step by step, until the one or the other of the two sets of brushes engages the terminals of the calling line; whereupon relay 352 is held operated and one or the other of relays 241 and 242 are operated. Assuming the calling line L1 to be found by the upper set of brushes, a circuit is closed for holding the stepping relay 352 operated and for operating relay 241. This circuit is traced from ground through the upper winding of relay 352, inner upper front contact of relay 353, uppermost back contact of relay

354, brush and terminal of bank 372 of the allotter switch, conductor 139, lowermost back contact of relay 242, lower winding of relay 241, back contact of the release magnet 249, test brush 133, conductor 116, left front contact of relay 111, through the middle winding of relay 111 to battery. In addition to holding relay 352, the current in this circuit is effective to complete the operation of relay 111 and to energize the lower winding of relay 241. Relay 241 is thereby partially operated, closing a circuit from battery through its upper winding and inner upper front contact, the lowermost back contact of relay 242, conductor 283, inner lower back contact of relay 403 of trunk circuit MRT, conductor 413 to ground at the inner lower front contact of relay 502 of selector S1. With relay 241 completely operated by its upper winding, the line L1 is connected through brushes 131 and 132, front contacts of relay 241, conductors 281 and 282, windings of relay 400, back contacts of relay 407, conductors 411 and 412, back contacts of relay 504, to the windings of relay 501. The other side of the lower winding of relay 501 is connected through a back contact of the eleventh rotary step springs 510, a back contact of relay 506 and through one winding of the dial tone transformer 507 to ground, so as to transmit dial tone to the calling subscriber. The complete operation of relay 241 disconnects the lower winding of relay 242 from conductor 139, disconnects the release magnet 249 from conductor 415, disconnects the lower winding of relay 352 from the contacts of magnets 243 and 244, and closes a circuit for holding relay 352 and operating relay 354. This circuit is traced from battery through the lower winding of relay 352, inner upper front contact of relay 351, brush and terminal of bank 374 of the allotter switch, conductor 295, back contact of the eleventh rotary step springs 246, upper back contact of relay 242, middle upper front contact of relay 241, conductor 290, through the upper winding of relay 354 to ground. With relay 241 operated, the complete operation of the line and cut-off relay 111 is effected by the connection of the grounded conductor 283 through the outer lower back contact of relay 242, inner front contacts of relay 241, and back contact of release magnet 249, terminal engaged by brush 133, thence through conductor 116, and left front contact of relay 111 to the middle winding of relay 111. With relay 354 operated, a locking circuit is closed through the lower winding and lower front contact of relay 354, through brush and engaged terminal of bank 371 of the allotter switch, conductor 296, lower back contact of the make-busy key MB of the line finder LF1, to ground at the lower front contact of vertical off-normal springs 245. Relay 354 disconnects ground from the contact of stepping relay 352 to prevent further operation of the rotary stepping magnet 244, and opens the circuit path through the brush and terminal of the bank 375 of the allotter switch and the winding of relay 391, thereby causing the release of relay 391. The line relay 501 of selector S1 does not release since it is held operated in series with the calling subscriber's station. The operation of relay 354 also opens the circuit through the upper winding of relay 352 and causes the release of relay 351. The release of relay 351 opens the circuit through the lower winding of relay 352 to cause the release of relay 352, opens a circuit for holding relay 357 operated, and causes the release of relay 353. Relay 357 remains operated if one of the finders in the same subgroup is idle at the time that relay 351 releases. In releasing, relay 353 closes a circuit for operating the stepping magnet 370 of the allotter switch, this circuit being traced through the winding and interrupter contact of magnet 370, upper front contact of relay 354, inner lower back contact of relay 353, to ground at the front contact of relay 357. The operation and release of magnet 370 steps the brushes of the allotter switch to the next set of terminals. If the line finder connected to this set of terminals is busy, relay 354 is held operated. The stepping magnet 370 is thus alternately operated and released, to advance the brushes of the allotter switch, step by step, until brush 371 encounters a terminal connected to an idle finder. When an idle finder is encountered, relay 354 releases and stops the allotter. The aforementioned release of relay 351 also opens the locking circuit of relay 394, causing the release of relay 394.

When line relay 501 of selector circuit S1 releases, due to the opening of the circuit through its upper winding during the time that relay 392 of line finder LF1 is released and relay 393 is operated as hereinbefore described, it closes a circuit from ground at the inner upper back contact of relay 504 through the back contact of relay 501, front contact of relay 502, winding of relay 503, and winding of vertical stepping magnet 511, thereby causing the operation of relay 503 and stepping magnet 511. The operation of magnet 511 raises the brushes 521, 522, 523 and 524 one step, the vertical off-normal springs 509 being actuated as soon as the shaft, on which the brushes are mounted, moves out of its normal position. With relay 503 operated and springs 509 actuated, a circuit is closed for operating relay 505, this circuit being traced from the winding of relay 505, through the lower back contact of the eleventh rotary step springs 510, the upper front contact of the vertical off-normal springs 509, outer front contact of relay 503, to ground at back contact of release magnet 513. Relay 505 closes a locking circuit traced from its winding through the aforementioned contacts of springs 510 and 509, through the back contact of rotary stepping magnet 512, lower front contact of relay 505, thence to ground at a front contact of relay 502. When relay 501 reoperates, at the end of the impulse, the circuit through the windings of relay 503 and magnet 511 is opened; and, since no further impulses are received until the calling subscriber starts to dial, both the magnet 511 and relay 503 release.

The normal post springs 525 are actuated when the brushes are on the first level and the springs 526 are actuated when the brushes are on any level corresponding to a digit which is to be absorbed. The actuation of the normal post springs 525, when the brushes are raised to the first level, connects ground through conductor 420 and a back contact of relay 406 of trunk circuit MRT, to the winding of relay 403. Relay 403 operates, opening the connection between incoming sleeve conductor 283 and outgoing sleeve conductor 413; connecting ground to conductor 283 to hold the connection with the calling line, connecting the winding of relay 404 to conductor 413; connecting ground through its lowermost front contact, a back contact of relay 405, and conductor 417 to the winding of relay 504 of selector S1; and connecting the anode of gas-filled tube 410 through the upper winding of relay 407 to anode battery. Relay 404 operates

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since conductor 413 is connected to ground at a front contact of relay 503, or, after relay 504 operates, to ground at a front contact of relay 1030 as hereinafter described. Relay 404 disconnects the class of service conductor 284 from ground; and connects conductor 284 to conductor 414 of selector S1.

The aforementioned release of relay 503 closes a circuit for operating the rotary stepping magnet 512, this circuit being traced from battery through the winding of magnet 512, back contact of normal post springs 526, lower back contact of relay 506, upper front contact of relay 505, lower back contact of relay 503, to ground at a back contact of release magnet 513. The operation of magnet 512 rotates the brushes into engagement with the first set of terminals in the first level of the bank and opens the locking circuit of relay 505. The release of relay 505 causes the release of the rotary stepping magnet 512. If the trunk connected to the first set of terminals in level 1 is busy, the terminal engaged by brush 523 is connected to ground potential; and this ground potential is further connected through brush 523, lowermost back contact of relay 504, lower back contact of release magnet 513, back contact of rotary stepping magnet 512, upper front contact of springs 509, lower back contact of springs 510, to the winding of relay 505, causing the reoperation of relay 505. Relay 505 again closes the circuit for operating the rotary stepping magnet 512, to advance the brushes to the next set of terminals. The reoperation of magnet 512 causes the release of relay 505, and the release of relay 505 causes the release of magnet 512. The operation and release of relay 505 and magnet 512 is continued, in this manner, until the brushes engage the terminals of an idle trunk or until the brushes reach the eleventh rotary position. If all the translating trunk circuits connected to terminals in the first level of switch S1 are busy when tested, the brushes of switch S1 are advanced by the interaction of relay 505 and stepping magnet 512 to the eleventh rotary position in which springs 510 are operated to prevent the further operation of relay 505 and to connect busy tone source 508 to the lower winding of line relay 501 to transmit an all-trunks-busy tone to the calling subscriber. When, in response to this tone, the subscriber restores the telephone set to normal, relay 501 releases. The release of relay 501 causes the release of relay 502, thereby disconnecting holding ground potential from conductor 413 to release the selector S1 and line finder LF1 as hereinafter described.

When the brushes of selector S1 encounter the terminals of an idle trunk, relay 504 operates since there is no ground potential connected to the terminal engaged by brush 523 to short-circuit the winding of relay 504. The circuit for operating relay 504 is traced from battery through the winding of relay 505, lower back contact of springs 510, upper front contact of springs 509, back contact of magnet 512, lower back contact of release magnet 513, winding of relay 504, conductor 417, upper back contact of relay 405, to ground at a front contact of relay 403. Relay 504 operates but relay 505 is marginal and does not operate in series with the winding of relay 504. Ground is momentarily connected from the inner lower front contact of relay 502, through the lowermost front contact of relay 504 and brush 523, to the test conductor of the seized trunk circuit to guard this trunk against seizure by any other hunting selector until it protects itself by the connection of ground to this conductor. Assume that the selected trunk is the translating trunk circuit TT shown in Figs. 6 to 14, inclusive. The operation of relay 504 causes the release of relay 501 and extends the connection from the calling subscriber's line through conductors 411 and 412, front contacts of relay 504, brushes 521 and 522, conductors 531 and 532, back contacts of relay 600, left windings of repeating coil 630, conductors 631 and 632, back contacts of relay 900, to the windings of line relay 680 of the translating trunk circuit TT connected to the selected set of terminals. Relay 680 is operated by the current in this circuit, closing a circuit for operating the slow-to-release relay 1030, this circuit being traced from ground through the upper front contact of relay 680, conductor 681, lower back contact of relay 730, conductor 732, to the winding of relay 1030. Relay 1030 connects ground through its middle lower front contact, conductor 1031 and upper back contact of relay 1050, back contact of relay 1055, conductor 533, to the terminal engaged by brush 523 to hold relay 504 of selector S1, this ground being further extended through the lowermost front contact of relay 504, conductor 413 and a front contact of relay 403 to hold relay 404; or, if relay 403 is normal, through a back contact of relay 403 to conductor 283 to hold relay 241 of the line finder LF1 and to hold the combined line and cut-off relay 111 of line circuit LC1.

The sender selector of translating trunk circuit TT is of the preselecting type and several trunk circuits may have preselected the same register sender. Whenever the register sender to which the trunk circuit TT is connected becomes busy, due to seizure of another of the trunk circuits to which the register sender is connected, the connection of ground potential to the terminal engaged by brush 1251 effects the operation of relay 1230. Relay 1230 closes a circuit for operating stepping magnet 1250. The operation of stepping magnet 1250 causes the release of relay 1230. The release of relay 1230 causes the release of stepping magnet 1250 advancing the brushes to the next position. The operations of relay 1230 and stepping magnet 1250 continue until the brushes are set on the terminals of an idle register sender.

When the translating trunk TT is seized and relay 1030 operates, ground is connected through the inner upper front contact of this relay, conductor 1032, outer back contact of relay 660, conductor 661, lower winding of relay 1220, conductor 1221, brush 1251 and engaged terminal in the ban kof the sender selector switch SS, conductor 1261, to battery through the winding of relay 1500 of the preselected register sender RS. Relay 1220 is immediately operated by the current in this circuit; and relay 1500 may operate; but relay 1230, which is normally connected to conductor 1221 in parallel with the winding of relay 1500, is marginal and does not operate. Relay 1220 opens the connection between the winding of relay 1230 and conductor 1221; short-circuits its lower winding so that the grounded conductor 661 is connected directly to the terminal engaged by brush 1251 to mark the register sender RS busy to prevent its selection by any other sender selector; and closes a locking circuit from battery through its upper winding and front contacts to conductor 661. Relay 1220 also closes a circuit from battery through the winding of relay 1210, conductor 1200, winding of relay 910 of trunk cir-

cuit TT, conductor 1201, front contacts of relay 1220, to conductor 661, thence to ground at a front contact of relay 1030. Relays 910 and 1210 are both operated by the current in this circuit. The operation of relay 910 closes a connection from the left winding of dial tone transformer 912, through condenser 911, front contact of relay 910, conductor 913, lower back contact of the eleventh rotary step springs 775 of selector TTS, conductor 776, inner upper back contact of relay 620, and back contact of relay 600 to conductor 531 in parallel with the upper left winding of repeating coil 630 and lower winding of relay 680, thereby transmitting dial tone to the calling subscriber.

The operation of relay 1210 operatively connects the preselected register sender to the translating trunk circuit TT, a circuit being closed from ground at the inner upper front contact of relay 1030, conductor 1032, uppermost back contact of relay 660, resistor 655, conductor 656, front contact of relay 1210, brush 1255 and engaged terminal, conductor 1265, winding of relay 1520 and winding of relay 1510 to battery. Relay 1520 operates but relay 1510 is marginal and does not operate in series with resistor 655. Relay 1520 connects ground through resistor 1525 and back contacts of relays 1541, 1540, 1531 and 1530, through conductor 1266, terminal and brush 1256, front contact of relay 1210, conductor 1206, to the winding of relay 700 to start the operation of alarm apparatus as hereinafter described in detail. Relay 1520 closes a circuit, including a back contact of relay 1504, for operating relay 1501; relay 1501 closes a circuit for operating relay 1502; relay 1502 closes a circuit for operating relay 1503; and relay 1503 closes a circuit for operating relay 1504. Relay 1502 also closes a circuit, including a back contact of relay 1510, for holding relay 1501 operated after relay 1504 operates.

Calling subscriber dials

When the calling subscriber dials the directory listed office code and number of the station with which connection is desired, relay 680 is released at the beginning of each dial impulse and reoperated at the end of each impulse. The release of relay 680, in response to the first impulse of each train of impulses received, closes a circuit for operating relay 1530 of the associated register sender, this circuit being traced from ground at the inner upper front contact of relay 1030, conductor 1032, uppermost back contact of relay 660, lower back contact of relay 680, conductor 1202, front contact of relay 1210, brush 1252 and engaged terminal, conductor 1262, through the winding of relay 1530 to battery. Relay 1530 is slow in releasing and remains operated during the transmission of each train of impulses over conductor 1202 to the register sender, the rotary magnets of the various register switches being successively controlled by these trains of impulses to register the digits dialed. The first train of impulses transmitted by relay 680 through conductors 1202 and 1262 to the winding of relay 1530 is further transmitted through conductor 1262, the back contact of off-normal springs RC13 of register control switch RC, to rotary stepping magnet RM10 of register switch R10, thereby setting the brush R11 of this switch in a position corresponding to the first digit dialed. The operation of relay 1530 closes a circuit for operating relay 1531; and when relay 1530 releases at the end of the first digit and while relay 1531 is releasing, a circuit is closed from ground at the lower back contact of relay 1530, through the back contact of relay 1570, lower front contact of relay 1531, and conductor 1532, for operating the rotary stepping magnet RCM10 to advance the brushes of the register control switch RC to the first off-normal position, in which conductor 1262 is connected to the rotary stepping magnet RM20 of the next register switch, the actuation of off-normal springs RC13 of switch RC being effective to disconnect conductor 1262 from magnet RM10. The next train of impulses received by relay 680 is in like manner repeated over conductors 1202 and 1262, through brush RC11, to operate magnet RM20 to set register R20 in a position corresponding to the second digit dialed. The control switch RC is advanced to position 2 at the end of the train, under the control of relays 1530 and 1531. Thus each train of impulses is repeated by relay 680 and registered in succession by register switches R10, R20, R30, R40, R50, R60, R70 and R80, as many of the register switches being set as there are trains of impulses received by relay 680. The operation of relay 1530, at the beginning of each train of impulses, momentarily disconnects ground from conductor 1266 to release relay 700, the operation of relay 1531 being effective to again connect ground to conductor 1266 to reoperate relay 700 and thereby again start the alarm timing.

When relay 680 releases in response to the first impulse of the first train of dial impulses received from the calling station, it closes a circuit from ground at its upper back contact, through back contacts of relays 600 and 610, conductor 612, a front contact of relay 1030, conductor 1033, a back contact of relay 950, conductor 951, lower back contact of vertical off-normal springs 744 of the selector TTS, winding of relay 750, and winding of vertical stepping magnet 740, to battery. A parallel circuit path is traced from conductor 951 through a back contact of relay 1188, to the windings of auxiliary impulse relay 1180. Thus the release of relay 680 causes the operation of relays 1180 and 750 and the operation of vertical stepping magnet 740 of selector TTS. The operation of magnet 740 is effective to step the brushes 800 up one step. The vertical off-normal springs 744 are actuated when the shaft on which the brushes are mounted moves out of normal position; whereupon the connection between conductor 951 and the winding of relay 750 is traced through the lower front contact of springs 744 and a front contact of relay 750, instead of through the lower back contact of springs 744. The actuation of springs 744 closes a short circuit across conductors 748 and 749 and the winding of relay 910 to release this relay and thereby end the transmission of dial tone to the calling subscriber. When relay 680 releases at the end of the impulse, stepping magnet 740 releases; but relay 750 is slow in releasing and remains operated until all of the impulses in the train created by the dialing of the first digit have been received by relay 680. The vertical stepping magnet 740 is released and reoperated under the control of relay 680 in response to each succeeding impulse of the train, thereby stepping the brushes of selector TTS up to the level corresponding to the digit dialed. The aforementioned operation of relay 750 closes a circuit path from battery through the winding of relay 930, upper winding of relay 920, conductor 923, upper front contact of relay 750, conductor 534, brush

524 of selector S1, front contact of relay 504, conductor 414 of trunk circuit MRT, front contact of relay 404, upper back contact of relay 406, upper back contact of relay 401, conductor 284, lowermost front contact of relay 241 of line finder LF1, brush 134, conductor 117, through the winding of message register 110 to ground. Relay 930 is marginal but the resistance of the register 110 is low, so that both of relays 920 and 930 operate to indicate that the calling line is entitled to extended service. If the call were from a restricted service station, conductor 117 of the subscriber's line circuit is free of ground potential so that neither of relays 920 and 930 are operated; and if the call is from a coin station, conductor 117 is connected to ground through a high enough resistance to prevent the operation of relay 930 but low enough to permit the operation of relay 920. If relay 920 is operated and relay 930 does not operate, a locking circuit is closed through the lower winding and front contact of relay 920, through a back contact of relay 930, conductor 931, a back contact of relay 1050, and through conductor 1031 to ground at relay 1030. If relay 930 is operated, it locks through its lower front contact, conductor 931, back contact of relay 1050 and conductor 1031, to ground at relay 1030. On the call being described, relay 930 locks but relay 920 releases when relay 750 releases after the reoperation of relay 680 at the end of the last impulse of the first digit.

At the same time that the vertical stepping magnet 740 is being actuated under the control of relay 680, the auxiliary impulse relay 1180 is being alternately operated and released to effect a corresponding number of operations of the vertical stepping magnet 1181 of the auxiliary selector AS. The operation of relay 1180 in response to the first impulse closes a circuit from battery through the winding of vertical stepping magnet 1181, winding of relay 1182, lower back contact of vertical off-normal springs 1183, right front contact of relay 1180, to ground at a back contact of release magnet 1184. Relay 1180 disconnects its right winding from conductor 951 and closes a locking circuit through this winding and left front contact until stepping magnet 1181 operates, the locking circuit being further traced through the back contact of magnet 1181, back contact of rotary stepping magnet 1185, conductor 952, a back contact of relay 950, conductor 1032 to ground at relay 1030. The operation of magnet 1181 raises the brushes 1150 and 1192 to 1199, inclusive, one step and opens the locking circuit of relay 1180. The release of relay 1180 causes the release of magnet 1181, but relay 1182 remains operated until all of the impulses in the train have been received. Each succeeding operation and release of relay 1180, in response to the first train of dial impulses received by relay 680, causes the operation and release of magnet 1181 whereby the brushes of auxiliary selector AS are raised to the level of the bank which corresponds to the first digit dialed by the calling subscriber. The vertical off-normal springs 1183 are actuated when the shaft on which the brushes are mounted is moved out of normal position, the circuit for operating magnet 1181 and relay 1182 being thereafter traced through the front contact of relay 1182 and lower front contact of springs 1183 instead of through the lower back contact of springs 1183. When relay 1182 releases, after relay 1180 has received the last impulse of the train, it connects the grounded conductor 952 to the commutator brush 1150. The first digit indicates whether or not the office code is a three-digit code, the terminals of commutator 1150 which correspond to the first digit of three-digit office codes being cross-connected through terminals of strips 1151 and 1152 to conductor 1154, and the terminals of commutator 1150 which correspond to the first digit of two-digit codes being cross-connected through terminals of strips 1151 and 1152 to conductor 1153. As shown in the drawings, terminals 2, 4 and 9 of strip 1151 are cross-connected to conductor 1153 and terminals 3, 5, 6, 7 and 8 of strip 1151 are cross-connected to conductor 1154.

If a preliminary accidental impulse is created prior to the dialing of the first digit after the calling line is connected to the translating trunk circuit TT, the brushes of switches TTS and AS are both raised to the first level of their terminal banks. When relay 1182 releases at the end of this impulse, relay 1187 is operated by the connection of grounded conductor 952, through the left back contact of relay 1182, brush and terminal 1 of commutator 1150, and inner left back contact of relay 1188, to the winding of relay 1187. The operation of relay 1187 causes the operation of release magnet 1184 to restore the brushes of switch AS to normal, relay 1187 and magnet 1184 being thereby released and vertical off-normal springs 1183 being restored to normal. When relay 750 releases at the end of this preliminary impulse, it closes a circuit for operating relay 1020 which is traced from the winding of this relay, through the lower back contact of relay 1000, a back contact of relay 1080, terminal 1 and brush of commutator 1010, conductor 1009, back contact of relay 1186, conductor 953, lowermost back contact of relay 950, conductor 954, back contact of relay 750, conductor 751, to ground at the continuity back contact of relay 1020. Relay 1020 locks through conductors 747 and 746 under control of the vertical off-normal springs 744, and closes a circuit through conductor 781 for operating release magnet 780, thereby restoring the brushes of switch TTS to normal. When the shaft reaches normal position, springs 744 restore to normal, releasing relay 1020 and magnet 780. The register switch R10 having been set in position 1 in response to the preliminary impulse, relay 1570 operates in a circuit through conductor 1571, terminal 1 and brush R11, to ground at the back contact of off-normal springs SC13 of sender control switch SC. With relay 1570 operated, the release of relay 1530 is not effective to advance the register control switch RC; and, when relay 1531 releases, a circuit is closed from ground at the lower back contact of relay 1530, front contact of relay 1570, inner back contact of relay 1531, conductor 1533, upper front contact of off-normal springs R13, to the winding of release magnet RM14. The operation of magnet RM14 restores the switch R10, including off-normal contacts R13, to normal. All of the switches AS, TTS and R10 are now ready to be selectively operated responsive to the dialing of the first digit by the calling subscriber.

If the first digit dialed is the first digit of a three-digit office code, the brush of commutator 1150 of switch AS is in engagement with a segment which is cross-connected to conductor 1154; and, when relay 1182 releases at the end of the train of impulses corresponding to the first digit dialed, it connects the left winding of relay 1155 to grounded conductor 952. Relay 1155 operates and closes a locking circuit through its right

winding and front contact to grounded conductor 952, connects the brushes 1192 to 1199, inclusive, to terminals 2 to 9, inclusive of commutator 1010 of selector TTS, and closes a circuit through its left front contact and a back contact of relay 1188 for operating relay 1187. Relay 1187 closes a circuit from ground at its front contact through the upper front contact of vertical off-normal springs 1183 for operating release magnet 1184 to restore the brushes of switch AS to normal. When the brushes reach normal, springs 1183 are restored to normal closing a circuit for operating relay 1188, this circuit being traced through the upper back contact of springs 1183, inner right front contact of relay 1155, to grounded conductor 952. Relay 1188 locks to conductor 952 and causes the release of relay 1187. The aforementioned operation of relay 1155 prevents the operation of rotary stepping magnet 770 of selector TTS in response to the next train of impulses received by relay 680; these impulses are, however, repeated by relay 680 to relay 1180, since conductor 951 is connected through a front contact of relay 1155 to the left winding of relay 1180.

If the first digit dialed is the first digit of a two-digit office code, the brush of commutator 1150 is in engagement with a commutator segment which is cross-connected to conductor 1153; and relay 1188 is operated as soon as relay 1182 releases. Relay 1188 locks to conductor 952; and, since relay 1155 is not operated, relay 1180 cannot respond to the succeeding trains of impulses received by relay 680. When the calling subscriber dials the second digit, relay 680 is alternately released and reoperated in response to each impulse thus created. The release of relay 680 in response to the first impulse of the train closes a circuit for operating rotary stepping magnet 770 and relay 1005. This circuit is traced from battery through the winding of stepping magnet 770, conductor 771, winding of relay 1005, conductor 1006, back contact of relay 1155, conductor 1002, upper back contact of relay 1000, conductor 752, inner lower back contact of relay 750, lower front contact of vertical off-normal springs 744, conductor 951, back contact of relay 950, conductor 1033, front contact of relay 1030, conductor 612, back contacts of relays 610 and 600, to ground at the upper back contact of relay 680. The operation of magnet 770 steps the brushes of switch TTS into engagement with the first set of terminals in the level which was selected responsive to the first digit. The operation of relay 1005 closes a circuit for operating relay 1000; and relay 1000 locks independent of relay 1005, through conductor 1032, to ground at a front contact of relay 1030. With relays 1005 and 1000 both operated, the circuit for energizing magnet 770 and relay 1005 in response to the first impulse of the second digit is opened; but magnet 770 and relay 1005 are held operated through the locking contact of relay 1005, front contact of the continuity springs of relay 1000 and conductor 752, thence to ground at the back contact of relay 680 as above described. When relay 680 reoperates at the end of the first impulse, stepping magnet 770 releases; but relay 1005 is slow in releasing and remains operated until after the reoperation of relay 680 at the end of the last impulse of the train created by the dialing of the second digit. The release and reoperation of relay 680, in response to each succeeding impulse of the train, causes a corresponding operation and release of stepping magnet 770, whereby the brushes of switch TTS are stepped into engagement with the particular set of terminals identified by the office code of the called subscriber's directory number. When relay 1005 releases, at the end of the second digit of a two-digit office code, a connection is closed from ground at the back contact of relay 1020, through conductor 751, back contact of relay 750, conductor 954, lowermost and uppermost back contacts of relay 950, conductor 955, back contact of relay 1310, conductor 1315, back contacts of relays 1070 and 1080, conductor 1085, lowermost back contact of relay 940, conductor 942, lower back contact of relay 1005, through conductor 694 and the lowermost brush of switch TTS to the engaged terminal. The lowermost terminal of each set of terminals in the bank of selector TTS, other than those on the first and tenth levels, is connected to a terminal of terminal strip 1191 for cross connection to any desired terminal of terminal strip 1190, the terminals in terminal strip 1190 being connected to the windings of the various office route relays, as hereinafter described.

If the first digit of the office code has been received and found to be the first digit of a three-digit office code, relays 1155 and 1188 are locked to conductor 952 as above described. When the calling subscriber dials the second digit of the called office code, relay 680 is alternately released and reoperated in response to each impulse thus created, thereby causing the alternate operation and release of relay 1180, the operating circuit for relay 1180 including a front contact of relay 1155 instead of a back contact of relay 1188. The vertical stepping magnet 1181 and relay 1182 are energized by each operation of relay 1180, the operations of magnet 1181 stepping the brushes of switch AS up the level corresponding to the second digit of the office code. The vertical off-normal springs 1183 are actuated when the shaft on which the brushes are mounted moves out of normal position. Relay 1182 is slow in releasing and remains operated until after the release of relay 1180 at the end of the last impulse of the train so as to maintain a circuit for energizing its own winding in series with the winding of magnet 1181 after the vertical off-normal springs 1183 are actuated. When relay 1182 releases, it prepares for the operation of the rotary stepping magnet 1185 and relay 1186 under the control of relay 1180. When the calling subscriber dials the third digit of the office code, relay 680 is alternately released and reoperated in response to each impulse thus created, causing the alternate operation and release of relay 1180. The operation of relay 1180, in response to the first impulse of the train, closes a circuit from battery through the winding of rotary stepping magnet 1185, winding of relay 1186, right back contact of relay 1182, lower front contact of vertical off-normal springs 1183, right front contact of relay 1180, to ground at the back contact of release magnet 1184. The operation of stepping magnet 1185 rotates the brushes of switch AS into engagement with the first set of terminals in the level selected responsive to the second digit of the office code. At the end of the first impulse, the release of relay 1180 causes the release of rotary stepping magnet 1185, but relay 1186 is slow in releasing and remains operated until after relay 1180 has released at the end of the last impulse of the train. Each succeeding operation and release of relay 1180 causes the reoperation and release of magnet

1185, thereby stepping the brushes of switch AS into engagement with the particular set of terminals corresponding to the last two digits of the office code. The aforementioned operation of relay 1186 closes a circuit for operating relay 1000, this circuit being traced from the winding of relay 1000, through conductor 1001, front contact of relay 1186, conductor 952, back contact of relay 950, through conductor 1032 to ground at a front contact of relay 1030. Relay 1000 locks, through conductor 1032, under control of relay 1030. While relay 1186 is operated, the brush of commutator 1010 of switch TTS is disconnected from conductor 953; but, when relay 1186 releases at the end of the third digit, a connection is closed from ground at the upper back contact of relay 1020, through conductor 751, back contact of relay 750, conductor 954, lowermost back contact of relay 950, conductor 953, back contact of relay 1186, and through conductor 1009 to the brush of commutator 1010. The segments 2 to 9, inclusive, of commutator 1010 are connected to brushes 1102 to 1109, inclusive, of switch AS; so that ground is connected to and through the commutator brush and the terminal corresponding to the first digit of the three digit office code dialed, thence through the corresponding one of conductors 1102 to 1109, front contact of relay 1155, and corresponding one of brushes 1192 to 1199 of selector AS, to the engaged terminal of the particular set of terminals in the bank of switch AS which is selected responsive to the dialing of the second and third digits of the called three-digit office code. The terminal set 1111 represents the first set of terminals in level 1 of the bank of switch AS; the terminal sets 1121 and 1122 represent the first and second sets of terminals in level 2; and the terminal sets 1131, 1132 and 1133 represent the first three sets of terminals in level 3. These sets and the other sets of terminals in the bank of switch AS which are selectable responsive to the last two digits of three-digit office codes, are connected to terminals of terminal strip 1191 for cross-connection to any desired terminal of terminal strip 1192.

The terminals of terminal strip 1190 are connected to windings of various route relays including relays 1050, 1060, 1070, 1080, 1310, 1320, 1330, 1340, 1350, and 1360, thereby enabling the operation of a route relay corresponding to the dialed two or three-digit office code on each call involving the use of trunk circuit TT. Relay 1050 is connected for operation when the local office code is dialed; that is, the code of the office in which trunk circuit TT is located; relay 1060 is connected for operation when the code dialed is a code which is not in use; relay 1070 is connected for operation when a special service code, for instance the repair service code 811 is dialed and the trunks on the tenth or "zero" level are used for completing such calls; relay 1080 is connected for operation when the long distance code 211 is dialed and a separate group of trunks are provided for such calls, these trunks being connected to terminals in the first level of the bank of selector TTS; relay 1310 is connected for operation when a special service code, for instance the information code 411, is dialed and the calls are completed over a separate group of trunks; relay 1320 is connected for operation when the called office is one having the same charging rate as calls within the local office in which trunk circuit TT is located; relay 1330 is connected for operation when the called office is another office having the same charging rate as calls within the local office, there being one relay such as relay 1330 for each such other office; each of relays 1340, 1350 and 1360 are connected for operation when the called office is one requiring more than one operation of the calling subscriber's message register for initial or repeated charges, there being as many such relays as there are different rates of charging. It is to be noted that one winding of each of these relays, excepting relay 1310, is connected to positive battery and another winding to negative battery, thereby enabling a transfer from loop pulsing to battery-ground impulsing when transmitting impulses are required on calls completed through the brushes of switch TTS as hereinafter described. Each of relays 1070, 1080 and 1310 has a winding connected to two terminals of terminal strip 1190, one connection including and the other excluding a resistor so as to adapt these relays for operation responsive to either two-digit or three-digit codes as hereinafter described in detail.

Call to zero operator

If the first digit dialed is the digit 0, the brushes of switches TTS and AS are advanced to the tenth level. As soon as relay 1182 releases, a circuit is closed through the brush and tenth segment of commutator 1150 for operating relay 1188; and as soon as relay 750 releases, a circuit is closed for operating the route relay 940, this circuit being traced from battery through the lower winding of relay 940, a back contact of relay 950, conductor 958, tenth segment and brush of commutator 1010 of switch TTS, conductor 1009, back contact of relay 1186, conductor 953, lowermost back contact of relay 950, conductor 954, back contact of relay 750, conductor 751, to ground at the back contact of relay 1020. Relay 940 closes a locking circuit through its upper winding and front contact through conductor 1031, to ground at relay 1030; and closes a circuit for operating relay 1040, which circuit is traced from the winding of relay 1040, conductor 941, a front contact of relay 940, conductor 772, back contact of rotary stepping magnet 770 of switch TTS, upper back contact of eleventh rotary step springs 775, conductor 777, uppermost front contact of relay 940, back contact of relay 950, conductor 958, terminal 10 and brush of commutator 1010, conductor 1009, back contact of relay 1186, conductor 953, lowermost back contact of relay 950, conductor 954, back contact of relay 750, to ground at a back contact of relay 1020. Relay 1040 locks, through its upper front contact independent of commutator 1010 under the control of rotary stepping magnet 770, and connects ground at the inner lower front contact of relay 1030, through the lower front contact of relay 1040 and conductor 771, to the winding of magnet 770. The operation of magnet 770 steps the brushes 800 into engagement with the first set of terminals in the tenth level of the associated terminal bank and opens the locking circuit of relay 1040. The release of relay 1040 causes the release of magnet 770. If the trunk connected to the engaged set of terminals is busy, the terminal engaged by the test brush is connected to ground potential and relay 1040 is reoperated in a circuit path extending from the winding of relay 1040, conductor 941, outer lower front contact of relay 940, conductor 772, back contact of magnet 770, upper back contact of eleventh rotary step

springs 775, conductor 777, inner lower back contact of relay 600, conductor 606, middle upper front contact of relay 940, conductor 693, through the test brush of switch TTS to the engaged grounded terminal. The reoperation of relay 1040 again closes the circuit for operating stepping magnet 770, thereby advancing the brushes to the next set of terminals. The brushes 800 are in this manner advanced by the cooperation of relay 1040 and magnet 770 until the brushes engage the terminals of an idle trunk or are advanced to the eleventh rotary position in case all of the sets of terminals are marked busy.

If the brushes are advanced to the eleventh rotary position, springs 775 are actuated to prevent the further reoperation of relay 1040 and to connect the busy tone source 777, through the front contact of springs 775, conductor 776, and back contacts of relays 620 and 600 to conductor 531 so as to transmit a busy tone to the calling subscriber. When, in response to the busy tone, the calling subscriber releases by restoring the telephone set to normal, relays 680 and 1030 release in succession. The release of relay 1030 disconnects ground potential from conductors 1031, 1032 and 1035, thereby causing the release of relay 404 of trunk circuit MRT and the release of relay 1520 of the register sender; and closes a circuit from the winding of relay 1020, through conductor 747, the uppermost front contact of vertical off-normal springs 744, conductor 746, upper back contact of relay 1030, conductor 612, back contacts of relays 610 and 600, to ground at the upper back contact of relay 680. Relay 1020 locks under control of springs 744 and closes a circcuit through conductor 781 for operating release magnet 780, thereby restoring the selector TTS to normal. The restoration of springs 744 effects the release of relay 1020 and the release of magnet 780. The ground potential connected to conductor 612 by the release of relay 680 is further connected through the upper back contact of relay 1030, conductor 1034, back contact of relay 1187, upper front contact of vertical off-normal springs 1183, to the winding of release magnet 1184 of switch AS, thereby causing the switch AS to be restored to normal. The restoration of springs 1183 to normal effects the release of magnet 1184. With relay 1030 released and both of switches TTS and AS normal, all operated relays in the translating trunk TT are released, and the trunk is ready for seizure on another call. The release of relay 1520 causes the register sender RS to be restored to normal as hereinafter described.

The aforementioned release of relay 404 of trunk circuit MRT closes an operating circuit through the upper winding of relay 405. Relay 405 closes a circuit from battery through the lower winding of relay 406, lower winding and locking contact of relay 405, a front contact of relay 403, conductor 420, and through the contact of normal post springs 525 to ground. Relay 406 is operated and relay 405 held by the current in this circuit. Relay 406 locks through its upper winding to ground at the inner lower front contact of relay 403, disconnects the winding of slow-to-release relay 403 from conductor 420, and connects ground through a back contact of relay 401 to conductor 284. The operation of relay 405 causes the release of relay 504 of selector S1; and, when relay 403 releases, ground is disconnected from conductor 283 causing the release of relays 241 and 111. The release of relay 504 closes a circuit, including back contacts of relays 504, 501, and 502 and the lower front contact of vertical off-normal springs 509, for operating release magnet 513. Magnet 513 locks under control of springs 509 and the brushes of switch S1 are restored to normal. The return of vertical off-normal springs 509 to normal, when the shaft of the switch reaches normal, opens the locking circuit of release magnet 513. The release of relay 403 also causes the release of relay 406, thereby disconnecting ground from conductor 284. With relay 241 released and release magnet 513 operated, a circuit is closed from battery through the winding of release magnet 249 of line finder LF1, back contacts of relays 241 and 242, upper front contact of vertical off-normal springs 245, and conductor 415, to ground at the front contact of release magnet 513, thereby operating release magnet 249 to restore the brushes of line finder LF1 to normal. When the shaft of switch LF1 reaches normal, the vertical off-normal springs 245 are restored to normal opening the operating circuit of release magnet 249.

If, however, one or more of the trunks connected to terminals in the tenth level of the bank of selector TTS are idle, the test brush does not encounter ground potential when it engages the test terminal of the first idle trunk; and the cut-through relay 600 is thereupon operated by the current in a circuit traced from battery through the winding of relay 1040, conductor 941, outer lower front contact of relay 940, conductor 772, back contact of rotary stepping magnet 770, upper back contact of eleventh rotary step springs 775, conductor 777, winding of relay 600, conductor 1031 to ground at relay 1030. Relay 1040 is marginal and does not operate in series with relay 600. Relay 600 disconnects conductors 531 and 532 from the windings of relay 680 and connects these conductors, through back contacts of relay 610, conductors 691 and 692, and brushes 800 to the talking conductors of the selected trunk circuit, for instance the trunk circuit OT1 connected to terminals 801. Upon seizure, the trunk circuit OT1 operates in well-known manner to connect holding ground potential to the terminal engaged by the test brush to mark the trunk busy and to hold the cut-through relay 600 of trunk circuit TT. Reference may be had to the patent to R. B. Buchanan et al. No. 2,233,282 of February 25, 1941, for disclosure of a trunk circuit and trunk to an operator's position. Relays 680 and 1030 release in succession; but, since relay 1030 is slow in releasing, ground potential is connected through conductor 1031 and the inner lower front contact of relay 600, conductor 606, middle upper front contact of relay 940, and conductor 693 to the test brush to mark the selected trunk circuit busy until the trunk circuit has effected the connection of holding ground potential to the terminal engaged by this brush. The holding ground potential connected to the lower front contact of relay 600 to hold this relay operated is further connected through conductor 1031, back contact of relay 1050, back contact of relay 1055, conductor 533, brush 523, front contact of relay 504, to conductor 413 to hold relay 404 of trunk circuit MRT. The operation of relay 600 also closes a class of service indicating circuit from ground at the inner upper front contact of relay 930, conductor 922, inner upper front contact of relay 600, conductor 603, a front contact of relay 940, conductor 942, back contact of relay 1005, conductor 694, through the lowermost brush of switch TTS to

trunk circuit OT1. If the call were from a coin line, relay 920 would be operated, and ground potential would be connected through resistor 922 and the lowermost brush of selector TTS to the selected trunk circuit. If the call were from a restricted service line, neither relay 920 nor 930 would be operated, and no ground potential would be connected through conductor 694 to trunk circuit OT1. Thus a class of service relay in trunk circuit OT1 is selectively controlled to effect the transmission of a class of service indication to the answering operator as described in the aforementioned Buchanan et al. patent. The aforementioned release of relay 1030 disconnects ground potential from conductor 1032, thereby releasing relay 1520 of register sender RS to effect the return of the register R10 and register control switch RC10 to normal as hereinafter described.

The connection between the calling line and the trunk OT1 is maintained under the joint control of the calling subscriber and answering operator. When the connection is released by both the operator and the calling subscriber, ground is disconnected in the trunk circuit OT1 from the terminal engaged by the test brush thereby causing the release of relays 600 and 404. Whereupon release of the translating trunk circuit TT, including selectors TTS and AS, and release of the selector S1 and line finder LF1 are effected in the manner hereinbefore described in case an all-trunks-busy condition is encountered.

Calling subscriber dials unassigned office code

If the calling subscriber dials an office code for which there is no corresponding office, relay 1060 is operated after all of the dial impulses of the office code digits have been received. If, for instance, the unassigned two-digit office code 31 is dialed, the brushes of switch TTS are advanced into engagement with terminal set 831, the lowest terminal of this set being connected through conductor A31, cross-connected terminals of terminal strips 1191 and 1190 and conductor 1052 to the upper winding of relay 1060. When relay 1005 releases after the last impulse of the second digit, the connection of ground to the lowermost brush of switch TTS, as above described, effects the operative energization of the upper winding of relay 1060; and relay 1060 locks through its lower winding and locking contact to grounded conductor 1031. If, for instance, the unassigned three-digit office code 711 is dialed, the brushes of switch TTS are raised to the seventh level and the brushes of switch AS are advanced into engagement with the first set of terminals in the first level. The terminal engaged by brush 1197 is connected through conductor A711, cross-connected terminals of terminal strips 1191 and 1190, and conductor 1061 to the middle winding of relay 1060. When relay 1186 releases after receipt of the last impulse of the third digit, the middle winding of relay 1060 is operatively energized; and relay 1060 locks to conductor 1031. When relay 1060 operates, due to the dialing of an unassigned office code of either two or three digits, it closes a circuit for operating relay 1020. This circuit is traced from ground at the inner upper front contact of relay 1060 through conductor 956, continuity back contact of relay 950, conductors 957 and 746, upper front contact of springs 744, conductor 747, to the winding of relay 1020. Relay 1020 locks under control of springs 744, closes a circuit for operating release magnet 780, and closes a circuit from ground at the upper front contact of relay 1020, through conductor 1034, back contact of relay 1187 and upper front contact of springs 1183, for operating release magnet 1184. The operation of release magnet 780 restores the brushes of switch TTS to normal and the operation of release magnet 1184 restores the brushes of switch AS to normal. When switch TTS reaches normal, springs 744 are restored to normal, releasing relay 1020 and release magnet 780; and, when switch AS reaches normal, springs 1183 are restored to normal, releasing release magnet 1184. Relay 1000 having been operated and locked, when relay 1005 operates on two-digit codes or when relay 1186 operates on three-digit offices codes as hereinbefore described, the restoration of springs 744 to normal closes a circuit for operating relay 950, this circuit being traced from the winding of relay 950, through conductor 1003, lower front contact of relay 1000, conductor 745, upper back contact of springs 744, conductors 746 and 957, back contact of the continuity spring of relay 950, conductor 956, to ground at a front contact of relay 1060. Relay 950 locks through the front contact of its continuity spring to the same ground, connects ground to the tenth segment of commutator 1011, and closes a circuit for operating relay 760; this circuit is traced from the winding of relay 760, conductor 761, front contact of relay 950, conductor 961, back contact of vertical stepping magnet 740, conductor 962, to ground at a back contact of relay 960. The operation of relay 760 connects the winding of stepping magnet 740 to conductor 962, thereby operating magnet 740 to step the brushes of switch TTS up to the first level of the bank. The operation of magnet 740 causes the release of relay 760, and the release of relay 760 causes the release of magnet 740. Relay 760 and stepping magnet 740 are in this manner alternately operated and released to raise the brushes step by step until the brush of commutator 1010 engages the segment to which ground has been connected by the operation of relay 950. Since the operation of relay 950 connected ground to the tenth commutator segment, the brushes of switch TTS are stepped up to the tenth level; whereupon a circuit is closed from ground at the middle upper front contact of relay 950, through conductor 955, segment 10 and brush of commutator 1010, conductor 1009, back contact of relay 1186, conductor 953, front contact of relay 950, continuity back contact and winding of relay 960, front contact of relay 950, conductor 761, to the winding of relay 760. Relay 760 is marginal and does not reoperate in series with the winding of relay 960, but relay 960 operates, locking to ground at its inner lower front contact and opening the operating circuit of stepping magnet 740. The operation of relay 960 closes a circuit for operating relay 1040, traced from the winding of relay 1040, conductor 941, front contact of relay 960, conductor 772, back contact of rotary stepping magnet 770, upper back contact of eleventh rotary stepping springs 775, conductor 777, uppermost front contact of relay 960, lowermost front contact of relay 950, conductor 953, back contact of relay 1186, conductor 1009, brush and segment 10 of commutator 1010, to ground at a front contact of relay 950. Relay 1040 locks to ground at a back contact of relay 1020 under control of stepping magnet 740 and closes a circuit for operating magnet 740, which circuit does not include the winding of relay 1005. The operation of magnet 740 causes the release of relay 1040 and rotates the brushes of switch TTS one step into engagement with the

first set of terminals in the tenth level. The release of relay 1040 causes the release of magnet 770. If the trunk connected to this set of terminals is busy, the winding of relay 600 is short-circuited by ground potential encountered by the test brush; and relay 1040 and stepping magnet 770 are reoperated to advance the brushes step by step until the terminals of an idle trunk are encountered, whereupon the cut-through relay 600 is operated as hereinbefore described to extend the connection from the calling line, through the selected trunk to an operator. The operation of relay 600 causes the release of relays 680 and 1030; and the release of relay 1030 disconnects ground from conductor 1032 to release relay 1520 in the register sender to effect the return of the registers and register control switch to normal in the manner hereinafter described. Release of the connection is effected as described above on a call to zero operator.

Local office call

Assume now that the calling subscriber dials the local office code, which code may be either a two-digit code or a three-digit code. If the local office code is a two-digit code the above-described connection of ground to the terminal engaged by the lowest brush of switch TTS, when relay 1005 releases at the end of the second digit, causes the operation of route relay 1050. If the local office code is a three-digit code, the above-described connection of ground to the terminal engaged by that one of the brushes of selector AS which corresponds to the first digit of the code, when relay 1186 releases at the end of the third digit of the code, causes the operation of relay 1050. As shown in the drawings, the local office code is 22, and the terminal of terminal set 822, which is engaged by the lowest brush of switch TTS, is connected through conductor A22, terminals of strips 1191 and 1190, and conductor 1051 to the lower winding of relay 1050. The operation of relay 1050 disconnects ground from conductor 533 and closes a circuit for operating the slow-to-operate relay 1055. The disconnection of ground from conductor 533 causes the release of relay 404 of trunk circuit MRT, operation of relay 405, operation of relay 406, release of relay 504 of selector S1, operation of release magnet 513 of selector S1, return of the brushes of selector S1 to normal, release of relay 403 of trunk circuit MRT, and release of relay 405 all as above described upon release of a connection to zero operator. The release of relay 504 causes the release of relays 680 and 1030 in succession, disconnecting ground potential from conductors 1031, 1032 and 1035 to release all relays which are holding through these conductors, and operating relay 1020. The circuit for operating relay 1020 is traced from ground at the upper back contact of relay 680, through back contacts of relays 600 and 610, conductor 612, upper back contact of relay 1030, conductor 746, upper front contact of off-normal springs 744, conductor 747, and winding of relay 1020. Relay 1020 locks under control of springs 744 and connects ground to conductor 781 to operate release magnet 780 to return the brushes of switch TTS to normal. The ground connected to conductor 612 is further connected through the upper back contact of relay 1030, conductor 1034, back contact of relay 1187, upper front contact of off-normal springs 1183, to the winding of release magnet 1184, the operation of magnet 1184 being effective to restore the brushes of selector AS to normal. When the brushes of switches TTS and AS reach normal, the off-normal springs 744 and 1183 are restored to normal, thereby releasing magnets 780 and 1184. The aforementioned release of relay 1030 and disconnection of ground from conductor 1032 causes the release of relay 1520 to effect the restoration of the register sender RS to normal in the manner hereinafter described.

Since in the case of a local call the receiver has not been restored to normal at the calling station, relays 501 and 502 of selector S1 are reoperated when relay 504 releases; and, since relay 403 is slow in releasing, relay 502 connects ground to conductor 413, thence through the continuity contact of relay 403, to conductor 283 to hold the line finder relay 241 and combined line and cut-off relay 111 after relay 403 releases. Relay 406 is held operated, by current through its upper winding and locking contact, to grounded conductor 283. As soon as the slow-to-operate relay 1055 of trunk circuit TT is operated, ground is reconnected to conductor 533 to guard the trunk circuit against seizure while it is being restored to normal. The subscriber proceeds to dial the numerical digits of the directory number of the station with which connection is desired. Relay 501 is alternately released and reoperated in response to each impulse of the train created by the dialing of the first digit of the numerical code. The release of relay 501 in response to each impulse of the train closes a circuit for operating vertical stepping magnet 511 and relay 503 in series. When relay 501 releases at the end of each impulse, stepping magnet 511 releases; but relay 503 is slow in releasing and remains operated until the last impulse of the train has been received. The brushes of switch S1 are thereby stepped up to the level corresponding to the digit dialed. The actuation of vertical off-normal springs 509 when the shaft of selector S1 moves out of normal position closes a circuit for operating relay 505, and relay 505 locks under control of rotary stepping magnet 512.

If the next digit dialed, after release of trunk circuit TT, is the digit 1, the actuation of normal post springs 525 connects ground through conductor 420, lower front contact of relay 406 to conductor 421, to simulate an all-trunks-busy condition, relay 505 and rotary stepping magnet 512 being thereupon operated to step the brushes of selector S1 to the eleventh rotary position in which the actuation of springs 510 connects the left winding of busy tone source 508 to the lower winding of relay 501 to transmit a busy tone to the calling subscriber; and when the calling subscriber restores the receiver, the release of relay 501 causes the selector S1 and line finder LF1 to be restored to normal. If the next digit dialed, after release of trunk circuit TT, is one which is to be absorbed, normal post springs 526 are actuated when the brushes of selector S1 are stepped up to the level corresponding to this digit; and, when relay 503 releases, at the end of the train, a circuit is closed for operating release magnet 513. The circuit for operating release magnet 513 is traced from its winding through the lower contact of vertical off-normal springs 509, front contact of normal post springs 526, a back contact of relay 506, a front contact of relay 505, back contact of relay 503 to ground at the continuity back contact of release magnet 513. The release magnet locks under control of the vertical off-normal springs 509; causes the shaft and brushes

to be restored to normal; and closes a circuit for operating relay 506, this circuit being traced from the winding of relay 506, through the front contact of release magnet 513, lower front contact of relay 505, to ground at a front contact of relay 502. Relay 506 locks under the sole control of relay 502, disconnects the dial tone source 507, connects ground to the lower winding of relay 501, and connects the winding of rotary stepping magnet 512, to the upper contact of relay 505 independent of normal post springs 526. The off-normal springs 526 are restored to normal when the shaft of switch S1 reaches normal position, thereby causing the release of magnet 513 and the release of relay 505. When the calling subscriber dials the next digit of the numerical code, relay 501 is again alternately released and reoperated, controlling relay 503 and stepping magnet 511 to step the brushes up to the level corresponding to the digit dialed. Relay 505 is again operated, when the vertical off-normal springs 509 are actuated, and locked under control of rotary stepping magnet 512. When relay 503 releases, after the reoperation of relay 501 at the end of the last impulse of the train, the rotary stepping magnet 512 is operated to step the brushes into engagement with the first set of terminals in the selected level. When stepping magnet 512 operates, relay 505 releases, thus causing the release of magnet 512. If the connector switch which is connected to the engaged terminals is busy, the terminal engaged by brush 503 is connected to ground potential, thus causing the reoperation of relay 505. The reoperation of relay 505 causes the reoperation of stepping magnet 512 thus advancing the brushes to the next set of terminals. The cooperation of relay 505 and stepping magnet 512 continues to advance the brushes step by step until brush 523 engages a terminal which is not connected to ground potential, whereupon relay 504 is operated in series with the winding of relay 505, relay 505 remaining normal. The operation of relay 504 connects the calling line to and through the brushes of switch S1 to a connector switch C2 having access to the called line. Holding ground potential is connected by the seized switch C2 to the terminal engaged by brush 523 in usual and well-known manner to hold relay 504 after relays 501 and 502 have released.

The dialing of the last two digits of the numerical code of the called station's number effects the operation of the connector switch C2, in usual and well-known manner, to complete the connection with the called line. The called line is tested and, if found idle, ringing current is transmitted to the called station in the usual manner. If the call is answered, the connector C2 effects in usual manner the reversal of the current through the windings of polarized relay 400 of trunk circuit MRT to cause its operation. If the calling station is a message rate station, requiring meter operation on local calls, the operation of relay 400 closes a circuit from ground at pick-up interrupter 288, through normal post springs 287 of the line-finder switch LF1 (these springs being actuated when the calling line is found on a level on which message rate lines are terminated), conductor 286, back contacts of relays 401 and 402, front contact of relay 400, through the upper winding of relay 401 to battery. Relay 401 operates and when the interrupter 288 next disconnects ground from conductor 286, relay 401 is held operated by the energization of both of its windings in series under the control of relays 400 and 402. When ground is next connected to conductor 286 by interrupter 288, relay 402 is operated. Relay 401 is held to conductor 286 until the interrupter again disconnects ground from conductor 286, at which time relay 402 is locked through the front contact of its continuity springs to holding ground connected to sleeve conductor 283. While relay 401 is held operated after relay 402 operates, battery is connected through the outer upper front contacts of relays 402 and 401 to conductor 284 to operate the calling subscriber's message register 110.

The talking connection is maintained until released by the calling subscriber at which time the connector C2 disconnects holding ground potential from the terminal engaged by brush 523 thereby releasing relays 504, 402, 406, 241 and 111. The selector S1 and line finder LF1 are thereupon restored to normal in usual manner.

If the selector S1 is being operated to hunt for an idle set of terminals in a level, and all of the terminals in this level test busy, the brushes are rotated into the eleventh position, in which position springs 510 are actuated to prevent further operation of relay 505 and stepping magnet 512 and to connect the lower winding of relay 501 to busy tone source 508. When the calling subscriber restores the receiver to normal, relays 501 and 502 release, and switches S1 and LF1 are restored to normal.

Call to toll operator

Assume now that the special service code 211 is dialed, the brushes of switch TS being thereby stepped into engagement with terminals 821, the first set of terminals in the second level of the bank, in response to the first two digits. The operation of relay 1005 at the beginning of the second train of impulses closes the circuit for operating relay 1000; and, when relay 1005 releases at the end of the second train of impulses, it closes a circuit for energizing the middle winding of relay 1080. This circuit is traced from battery through the middle winding of relay 1080, through resistor 1082, conductor 1083, terminal of strip 1190, cross-connecting conductor, terminal of strip 1191, conductor A21, lowest terminal of terminal set 821 and lowest brush of brushes 800, conductor 694, lower back contact of relay 1005, conductor 942, back contact of relay 940, conductor 1085, back contacts of relays 1080, 1070 and 1310, conductor 955, uppermost back contact of relay 950, lowermost back contact of relay 950, conductor 954, back contact of relay 750, conductor 751, to ground at a back contact of relay 1020. Resistor 1082 limits the current in this circuit to prevent the operation of relay 1080. Although the digit 2 is the first digit of two digit office codes, the calling subscriber dials the third digit of the code 211. The release of relay 680, in response to the single impulse thus created, closes a circuit from ground at the back contact of relay 680, through back contacts of relays 690 and 610, conductor 612, front contact of relay 1030, conductor 1033, back contact of relay 950, conductor 951, front contact of springs 744, back contact of relay 750, conductor 752, front contact of relay 1000, back contact of relay 1005, through the back contact of the continuity springs and upper winding of relay 1080, to battery. With both its middle and upper windings energized, relay 1080 operates and locks to conductor 1031. The upper winding of relay 1070 and lower winding of relay 1310 are also energized when relay 680 releases; but these relays are marginal and the energization of these windings alone does not

effect operation. The operation of relay 1080 connects ground to the first segment of commutator 1011 and connects ground to conductor 956 to operate relay 1020 and thus effects the return of selectors TS and AS to normal as above described. When vertical off-normal springs 744 are restored to normal, relay 950 is operated as above described to close a circuit for operating relay 760. Relay 760 closes the circuit for operating vertical stepping magnet 740 and the brushes of selector TS are thereupon stepped up to the first level. When the brush of commutator 1010 engages the first commutator segment, a circuit is closed from ground at the front contact of relay 1080, through segment 1 and brush of commutator 1010, conductor 1009, back contact of relay 1186, conductor 953, lowermost front contact of relay 950, continuity back contact and winding of relay 960, another front contact of relay 950, conductor 761, through the winding of relay 760 to battery. Relay 960 operates but relay 760 is marginal and does not operate in series with relay 960. Relay 960 locks independent of brush 1010 and closes a circuit for operating relay 1040, thereby causing the selector TS to be operated to select a set of terminals in level 1 of its bank, the terminals in this level being connected to trunks to a toll operator. The operation of relay 600, when an idle trunk is found, connects the calling line to the selected trunk circuit, the connection being under the joint control of the calling subscriber and answering operator.

If the digit 2 were the first digit of three digit office codes instead of the first digit of two digit codes, the middle winding of relay 1080 would be connected, through conductor 1081 and cross-connected terminals of terminal strips 1191 and 1190, to the terminal of terminal set 1111 which is engaged by brush 1192 of auxiliary selector AS in response to the dialing of the last two digits of the code 211, the resulting energization of the middle winding of relay 1080 being immediately effective to operate this relay and thereby cause the return of selectors TS and AS to normal and the reoperation of selector TS to select an idle trunk to a toll operator's position.

Call to repair clerk

Assume next that the call is a special service call for instance a call to repair clerk for which the code 611 is dialed. In this case, relay 1070 is operated after the third digit of the code has been dialed. The circuit for operating relay 1070 is traced from battery through the middle winding of relay 1070, conductor 1071, terminal of strip 1190, cross-connecting conductor and terminal of strip 1191, conductor A611, terminal of set 1111 with which brush 1196 is in engagement, front contact of relay 1155, conductor 1106, through terminal 6 and brush of commutator 1010, conductor 1009, back contact of relay 1186, conductor 953, lowermost back contact of relay 950, conductor 954, back contact of relay 750, to ground at a back contact of relay 1020. Relay 1070 locks through its upper winding and inner upper front contact, through conductor 1031 to ground at relay 1030. Relay 1070 connects ground to conductor 956, thereby operating relay 1020 to restore the selectors TSA and AS to normal in the manner hereinbefore described. When the vertical off-normal springs 744 are restored to normal, relay 950 is operated as above described to connect ground to the tenth-level segment of commutator 1010, and to close the circuit for operating relay 760 to cause selector TS to be stepped up to the tenth level. When the brush of commutator 1010 engages the grounded segment of the tenth level, relay 960 is operated as above described. Relay 960 closes the circuit for operating relay 1040 and the brushes of selector TS are advanced in the tenth level to hunt for a set of terminals connected to an idle trunk to "zero" operator. When an idle trunk is found, relay 600 operates to connect the calling line to the selected trunk circuit, the connection being under the joint control of the calling subscriber and answering operator.

Call to information operator

A separate group of trunks to information operator being provided, these trunks are connected to the terminals in level 4 of selector TS for selection in response to the dialing of the special service code 411. On such a call, relay 1310 is operated after selector TS has been selectively operated to engage the first set of terminals in the fourth level of its bank in response to the dialing of the first two digits. The circuit for energizing the upper winding of relay 1310 is traced through resistor 1312, conductor 1313, cross-connected terminals of terminal strips 1190 and 1191, conductor A41, lowest terminal of set 841, lowest brush of selector TS, conductor 694, back contact of relay 1005, conductor 942, back contact of relay 940, conductor 1085, back contacts of relays 1080, 1070 and 1310, conductor 955, uppermost and lowermost back contacts of relay 950, conductor 954, back contact of relay 750, to ground at a back contact of relay 1020. Relay 1310 is thereby only partially energized. When relay 680 releases, responsive to the impulse created by the dialing of the third digit of the code 411, the lower winding of relay 1310 is energized in a circuit including the continuity back contact of relay 1310, conductor 1314, upper back contact of relay 1005, inner upper front contact of relay 1000, conductor 752, back contact of relay 750, lowermost front contact of springs 744, conductor 951, back contact of relay 950, conductor 1033, front contact of relay 1030, conductor 612, back contacts of relays 610 and 600, to ground at the back contact of relay 680. Relay 1310 closes a locking circuit through its lower winding and continuity front contact, under control of relay 1030. Since the brushes 800 are in engagement with the first set of terminals in level 4, relay 1040 operates if the trunk connected to these terminals is busy, the operating circuit being traced from battery through the winding of relay 1040, conductor 1317, front contact of relay 1310, conductors 1318 and 772, back contact of rotary stepping magnet 770, back contact of springs 775, conductor 777, inner lower back contact of relay 600, conductor 606, front contact of relay 1310, conductor 693 and test brush, to the grounded test terminal of the set of terminals 841. The operation of relay 1040 causes the brushes to be advanced as above described until the terminals of an idle trunk are encountered; whereupon relay 600 is operated to connect the calling line to the trunk in the manner above described, the connection being under the joint control of the calling subscriber and answering operator.

Call to step-by-step office—Office code not transmitted—Local charge

If the office code dialed is that of an office, the calls to which are charged at the same rate as local calls, and a group of trunks to this office

are connected to a level in the bank of selector TS, a route relay such as relay 1320 or a relay such as relay 1330 is operated by the dialing of the office code. Assume first that the called office code is 26, the brushes of selector TS being advanced into engagement with the sixth set of terminals in level two, which terminals are identified by the reference character 826. When relay 1005 operates in response to the first impulse of the second digit, relay 1060 operates as above described; and, when relay 1005 releases after the last impulse of the train, it closes a circuit for operating relay 1320, this circuit being traced from battery through the middle winding of relay 1320, conductor 1321, terminals and cross-connecting conductor of terminal strips 1190 and 1191, conductor A26, lowest terminal of set 826 and brush, conductor 694, back contact of relay 1005, conductor 942, back contact of relay 940, conductor 1085, back contacts of relays 1080, 1070 and 1310, conductor 955, uppermost and lowermost back contacts of relay 950, conductor 954, back contact of relay 750, to ground at the back contact of relay 1020. Relay 1320 locks through its upper winding and inner upper front contact through conductor 1032 to ground at relay 1030, connects ground to conductor 611 to operate relay 610, and connects ground through conductor 1323 to the fifth segment of commutator 1010, the trunks to office 26 being connected to terminals in the fifth level of the bank of selector TS. Relay 610 connects ground to conductor 533 to hold the selector S1 and line finder LF1, and connects the calling line to the winding of relay 680 independent of relay 600. Since the use of this group of trunks is not restricted, relay 1320 closes a circuit for operating relay 1020 without operating the restricted service relay 620, the circuit for operating relay 1020 being traced from battery through its winding, conductor 747, upper front contact of springs 744, conductors 746 and 957, back contact of the continuity spring of relay 950, conductor 956, front contact of relay 1320, to ground at a back contact of relay 1330. Relay 1020 locks and closes circuits for operating release magnet 780 of switch TS and release magnet 1184 of switch AS, thereby restoring these switches to normal. When the springs 744 are again normal relay 1020 releases and a circuit is closed for operating relay 950, this circuit being traced from battery through the winding of relay 950, conductor 1003, front contact of relay 1000, conductor 745, upper back contact of spring 744, conductors 746 and 957, back contact of the continuity spring of relay 950, conductor 956, front contact of relay 1320, to ground at a back contact of relay 1330. Relay 950 locks to the same ground and closes the circuit for operating relay 760 to effect the vertical stepping of the brushes of selector TS. When the brushes reach the fifth level, relay 960 is operatively connected through the brush of commutator 1010 to ground at a front contact of relay 1320. When relay 960 operates, it locks and closes a circuit for operating relay 1040 to start the trunk hunting operation of selector TS to select the first idle trunk connected to terminals in level 5. Relay 600 is operated when an idle trunk is found, thereby connecting the winding of relay 670 across the talking conductors of the selected trunk circuit. This connection is traced from the tip brush of selector TS, through conductor 691, a front contact of relay 610, a back contact of relay 620, upper back contact of relay 640, conductor 641, lower back contact of relay 970, conductor 971, continuity back contact of relay 665, winding of polarized relay 670, outer upper back contact of relay 665, conductor 667, upper continuity back contact of relay 975, conductor 642, lower back contact of relay 640, conductor 605, front contacts of relays 600 and 610, and conductor 692 to the ring brush of switch TS. The switching apparatus at the distant end of the selected trunk is thereby prepared for operation, but relay 670 does not operate at this time since the current through its winding is in the non-operate direction.

If the trunks on the selected level are trunks arranged for loop impulsing, the terminal engaged by the lowermost brush is connected through the winding of a route relay to negative battery; but if these trunks are arranged for battery-ground impulse transmission, the terminal engaged by this brush is connected through the winding of a route relay to positive battery. Assuming that the trunks on level five are arranged for battery-ground impulse transmission, that the brushes of switch TS are in engagement with the terminals 852, the trunk connected thereto having been the first idle trunk in the fifth level at the time the selector TS was trunk hunting, and that the code 52 is an unassigned office code, a circuit is closed from the negative pole of battery through the winding and continuity back contact of relay 970, conductor 972, a front contact of relay 600, conductor 607, uppermost front contact of relay 950, conductor 955, back contacts of relays 1310, 1070 and 1080, conductor 1085, lowermost back contact of relay 940, conductor 942, back contact of relay 1005, conductor 694, lowermost brush of switch TS and the engaged terminal of terminal set 852, conductor A52, terminals and cross-connecting conductor of strips 1191 and 1190, through conductor 1062 and the upper winding of relay 1060 to positive battery. Relay 970 operates in series with the upper winding of relay 1060 but relay 1060 does not operate. Relay 970 locks to conductor 1032 and at its lower back contacts opens the normally closed short circuit across the winding of relay 985, thereby operatively including this winding in the bridge across the conductors of the selected trunk T52. With relay 970 operated, the bridge across the selected trunk is rendered independent of the back contacts of relay 640 by parallel connections through conductors 981 and 982, back contacts of relay 980 and front contacts of relay 970. Relay 985 closes a circuit, through conductor 986, for operating relays 650 and 651 in series. Relays 651 and 650 lock in series through the front contact of relay 651 and conductor 963 to ground at a front contact of relay 960. Relay 650 short-circuits resistor 655 to cause the operation of marginal relay 1510 in the register sender and thereby initiates the transmission of impulses from the register sender to the outgoing impulse repeating relay 640. The operation of relay 1510 causes the successive release of relays 1501, 1502, 1503 and 1504; and the release of relay 1504 causes the successive reoperation of relays 1501, 1502, 1503 and 1504. Each release of relay 1502 connects ground to conductor 1263 to operate relay 640 and closes a circuit for operating relay 1540 in parallel with the rotary stepping magnet SM10 of sender switch S10, the next succeeding release of relay 1504 being effective to disconnect ground from conductors 1263 and 1505 to release the stepping magnet SM10 and relay 640. Being slow in releasing, relay 1540 remains operated

while all the impulses corresponding to a digit are being transmitted to relay 640. Relay 1540 disconnects ground from conductor 1266 to release relay 700, and closes a circuit for operating relay 1541, the operation of relay 1541 being effective to again connect ground to conductor 1266 to reoperate relay 700 to again start the alarm timing. The successive release and reoperation of relays 1501, 1502, 1503 and 1504 is thus effective to operate stepping magnet SM10 to advance brush S11 step by step. The connection of ground to conductor 1263 by each release of relay 1501 and disconnection of ground from conductor 1263 by each release of relay 1502 is effective to operate and release relay 640 in the translating trunk circuit once for each step that brush S11 is advanced. When the brush S11 reaches the terminal corresponding to the position in which the brush R11 of register R10 has been set, a circuit is closed for operating relay 1580. On the call in question, the first digit having been the digit "2", the brush R11 is in position 2; and, when the brush S11 reaches position 2, it closes a circuit for operating relay 1580; this circuit is traced from the upper winding of relay 1580; conductor 1581, brush S11 and engaged terminal 2, terminal 2 engaged by brush R11, to ground at the back contact of off-normal springs SC13 of the sender control switch SC. Relay 1580 operates and locks through its lower winding and conductor 1582, to ground at the lower front contact of off-normal springs S13 of switch S10. Relay 1580 closes a holding circuit for relay 1501, to stop the cyclic operation of relays 1501, 1502, 1503 and 1504, and thereby causes the successive release of relays 1540 and 1541. The successive release of these relays disconnects ground from and reconnects ground to conductor 1266 to release and reoperate relay 700 and thereby restart the alarm timing. Thus two impulses are transmitted over conductor 1263 to relay 640, corresponding to the digit 2 registered by the register R10. After relay 1540 releases and until relay 1541 releases, a circuit is closed, through conductor 1542, for operating the stepping magnet SCM10 of sender control switch SC to advance the brushes of this switch to position 1. The release of relay 1540 also closes a circuit through conductor 1545 and the upper front contact of off-normal springs S13 of switch S10 for operating release magnet SM14 to restore switch S10 to normal. When the brushes of switch S10 reach normal position, springs S13 are restored to normal and relay 1580 releases. When relay 1580 releases, the cyclic operation of relays 1501, 1502, 1503 and 1504 is started to effect the transmission of a train of impulses, corresponding to the digit registered by register switch R20, to relay 640 in the translating trunk and to close the circuits for operating relay 1540 and stepping magnet SM10 of switch S10. When the brush S11 of switch S10 reaches the terminal corresponding to the position in which register switch R20 has been set by the dialing of the second digit, it closes a circuit for operating relay 1580. On the call in question, the second digit being the digit "6," the circuit for operating relay 1580 includes brush S11 and engaged terminal 6, terminal 6 and brush R21 of register switch R20, through terminal 1 and brush SC11 of sender control switch SC10 to ground at a front contact of relay 1520. Thus relay 1580 is operated to stop the cyclic operation of relays 1501, 1502, 1503 and 1504 after a train of six impulses have been sent over conductor 1263 to relay 640. The successive release of relays 1540 and 1541 again operates release magnet SM14 to return switch S10 to normal; and operates stepping magnet SCM10 to advance the sender control switch SC10 to position 2. The release of relay 1580, when switch S10 reaches normal, again starts the cyclic operation of relays 1501, 1502, 1503 and 1504 to transmit a third train of impulses to relay 640, the number of impulses in the train being determined by the position to which register R30 has been advanced in response to the dialing of the third digit at the calling station. When switch S10 reaches the corresponding position, relay 1580 operates, relays 1540 and 1541 release, switch S10 is restored to normal, and sender control switch SC10 advances one position. In like manner, a train of impulses is transmitted to relay 640 for each additional digit registered in the register sender RS, the switch S10 being advanced to operate relay 1580 and end the train of impulses when it reaches the position corresponding to each of the off-normal registers R40, R50, R60, R70 and R80 in succession, the sender control switch being advanced one position for each train of impulses transmitted. Since on the call being described, the office code is a two-digit code and there are only four numerical digits, register R70 will not have been moved off-normal and only six trains of impulses will be transmitted. To this end relay 1580 is held operated, after switch S10 is restored to normal at the end of the sixth train of impulses, in a circuit through brush RC12 and engaged terminal 6 of register control switch RC10, terminal 6 and brush SC12 of sender control switch SC, through conductor 1521, to ground at a front contact of relay 1520.

Since relay 980 is normal during the transmission of the first two trains of impulses to relay 640, the operations of relay 640 are ineffective to repeat the impulses over trunk T52 to the called step-by-step office, the bridge comprising the windings of relays 670 and 985 being maintained across trunk T52 through back contacts of relay 980 in series with front contacts of relay 970. When the sender control switch reaches position 2, indicating that the trains of impulses corresponding to the first two digits registered, that is the office code digits, have been transmitted to relay 640, a circuit is closed for operating relay 1560, this circuit being traced from the winding of relay 1560, through conductor 1561, terminal 2 and brush SC12 of sender control switch SC and conductor 1521 to ground at a front contact of relay 1520. Since the call is a direct call to a step-by-step office and relay 970 is operated, the operation of relay 1560 closes a circuit for operating relays 1550 and 980, this circuit being traced from battery through the lower winding of relay 980, front contact of relay 970, conductor 973, front contact of relay 1210, brush 1254, conductor 1264, upper winding of relay 1550, to ground at a front contact of relay 1560. Relay 980 locks through its upper winding and front contact, through conductor 662, under control of relays 660 and 1030 and relay 1550 locks through its lower winding to ground at a front contact of relay 1520. The opening of the back contacts of relay 980 opens the short circuit around the outer back contacts of relay 640 so that the operations of relay 640 in response to the succeeding trains of impulses received from the register sender are effective to transmit impulses over the conductors of the selected trunk

T52 to effect the completion of the desired connection in the called step-by-step office. Relay 645 is operated when relay 640 operates in response to the first impulse of each train of impulses received over conductor 1263. Relay 645 is slow in releasing so as to remain operated while each train of impulses received by relay 640 is being repeated over the trunk to the step-by-step office, the winding of relay 670 being short-circuited during the repeating of each train of impulses by the upper front contact of relay 645. The operation of relay 645 closes a circuit from ground at relay 1030, through conductor 1032, a back contact of relay 660, conductor 662, a front contact of relay 645, conductor 646, and a front contact of relay 970 for operating relay 975. Relay 975 connects ground through resistor 976 to conductor 642, thence through contacts of relays 640, 600 and 610 and conductor 692, to one conductor of trunk T52; and connects battery through resistor 977 to conductor 641, thence through contacts of relays 640, 600 and 610 to conductor 691 to the other conductor of trunk T52. There is, therefore, a separate grounded circuit over each conductor of the trunk T52, each time relay 640 releases, to facilitate the reoperation of the impulse receiving relay in the called office. When the last impulse of each train has been repeated, the release of relay 640 continues long enough to release relays 645 and 975, thereby again bridging the winding of relay 670 across the conductors of the trunk. In case the numerical digits have not yet been registered when relay 1560 operates, relay 1580 is held operated through brush RC12 and terminal 2, through conductor 1562, to ground at a front contact of relay 1560; and, in like manner, the transmission of each succeeding train of impulses can be started only after the corresponding register switch has been set.

After sending the train of impulses corresponding to the last digit of the subscriber's number, relay 1580 is held operated through brushes RC12 and SC12 both in position 6, through conductor 1521 to ground at the inner lower front contact of relay 1520. This ground is also connected through conductor 1521, brush SC11 and terminal 6, conductor 1551, and front contact of relay 1550 to conductor 1266, to indicate to the trunk circuit TT that all trains of impulses have been transmitted. This connection of ground directly to conductor 1266 not only again operates relay 700 to once more start the alarm timing but is also effective to operate relays 660 and 665. The operation of relay 660 causes the release of relays 1520 and 1510 of the register sender. The release of relay 1510 connects ground through conductor 1511 and front contact of off-normal springs SC13 of sender control switch SC to operate release magnet SCM14 and thereby restore this switch to normal. The release of relay 1520 reconnects ground to conductor 1260 to indicate that the register sender RS is idle, connects ground from the off-normal springs of the various registers through conductor 1522 and a back contact of relay 1520 to conductor 1261 to hold relays 1530 and 1220; and closes circuits for operating the release magnet RCM14 of register control switch RC and the release magnet RM14 of register switch R10 to restore these switches to normal. When switch R10 reaches normal, its off-normal springs R13 close a circuit for operating the release magnet RM24 of register switch R20 to restore switch R20 to normal. Thus the release of each register switch, in turn, closes a circuit for operating the release magnet of the next register switch; whereby all register switches are restored to normal. When all of the registers are normal, ground is disconnected from conductors 1522 and 1261; and, with relay 660 operated as above described, ground is disconnected from conductors 661 and 1201 thereby causing the release of relays 1210, 1220 and 1500.

The impulses transmitted over trunk T52 effect the completion of the connection with the called line; and if the line is idle, the called station is signaled in usual manner. With relays 660 and 665 operated, relays 975 and 980 release and a supervisory connection is closed between repeating coil 630 and trunk T52, this connection being traced from conductor 691, through a front contact of relay 610, a back contact of relay 620, a back contact of relay 640, conductor 641, lower continuity back contact of relay 975, conductor 635, upper winding of repeating coil 630, retard coil 633, front contact of relay 680, upper front contact of relay 665, winding of relay 670, lower winding of repeating coil 630, conductor 667, upper continuity back contact of relay 975, conductor 642, lower back contact of relay 640, conductor 605, front contacts of relays 600 and 610, to conductor 692. When the called subscriber answers, relay 670 is operated by a reversal of the current over the conductors of the trunk. Relay 670 closes a circuit for operating relay 900. With route relay 1320 operated, the operation of relay 900 interchanges the connections between conductors 531 and 532 and the windings of relay 680 to reverse the current through the windings of relay 400 of trunk circuit MRT. The call in question being one for which the charge is the same as for local calls, the operation of relay 400 connects the upper winding of relay 401 to conductor 286, thence through level springs 287 to pick-up interrupter 288 if the calling line is a message rate line, the register of which is operated on local calls. Relay 401 is partially operated to connect its windings in series to ground at a back contact of relay 402. When the pick-up interrupter next disconnects ground from conductor 286, relay 401 is completely operated connecting the winding of relay 402 to conductor 286. When the interrupter next connects ground to conductor 286, relay 402 operates and locks to the holding ground connected to conductor 286. The operation of relay 402 causes the release of relay 401 when ground is again disconnected from conductor 286. While relay 401 is held operated after relay 402 operates, a circuit is closed from battery through resistor 425, front contacts of relays 402 and 401, conductor 284, a front contact of relay 241, brush 134, conductor 117 to the winding of message register 110, operating the register. When relay 401 releases, the register releases, no further operations of the register being required on the call in question.

When the connection is released by the calling subscriber relay 680 releases, in turn releasing relay 1030. The release of relay 1030 causes the release of all relays holding through its front contacts including the release of relays 600 and 610. With relays 610 and 1030 released, ground is disconnected from conductor 533 thereby causing the release of relay 504 of selector S1, and the release of relay 404 of trunk circuit MRT. The selector S1 and line finder LF1 are thereupon restored to normal as hereinbefore described.

The aforementioned release of relays 680 and 1030 closes a circuit for operating relay 1020 and relay 1020 closes the circuit for operating release magnet 780 to restore switch TS to normal.

If on the call to office 26, the selector TS finds the first five sets of terminals in the fifth level to be marked busy, the selector continues to advance to select a trunk to the tandem office instead of a direct trunk, in which case it is necessary to transmit the office code over the selected trunk as well as the numerical digits of the called subscriber's number. In this case relay 970 is not operated because the terminal engaged by the lowest brush is connected through a conductor such as A56, terminals of strips 1191 and 1190 and cross-connecting conductor, through the winding of a route relay, for instance the unassigned code relay 1060, to negative battery. Consequently, the impulses transmitted by the register sender RS will be repeated over the selected trunk by relay 640 as loop impulses, as hereinafter described on a call through the tandem office.

Call to step-by-step office—Office code transmitted—Local charge

Assume next that the office code dialed by the calling subscriber is the code 332, the called office being a step-by-step office reached through trunks on the sixth level and requiring the transmission of the office code as well as the numerical digits of the called subscriber's number, the charge being the same as for a local call. The selector AS having been set on terminals 1132 in response to the dialing of the office code in the manner hereinbefore described, the release of relay 1186 at the end of the third digit closes a circuit for operating a route relay 1330, the terminal engaged by brush 1193 being connected through conductor A332, terminals and cross-connecting conductor of strips 1191 and 1190, conductor 1332 and through the lower winding of relay 1330 to battery. Relay 1330 locks under control of relay 1030, closes a circuit for operating relay 1320, connects ground through conductor 1333 to the sixth segment of commutator 1010, and connects ground to conductor 956 to operate relay 1020 and thus cause the return of selectors TS and AS to normal in the manner hereinbefore described. When selector TS reaches normal, relay 950 is operated as above described. Since the trunks to office 332 are not restricted, relay 1320 closes the circuit for operating relay 610 and the selector TS is reoperated to select the sixth level and the terminals of an idle trunk therein in the manner hereinbefore described. Relay 970 is operated if the selected trunk is a direct trunk, the terminal engaged by the lowest brush being connected through the winding of a route relay to positive battery; but, if the selected trunk is a common trunk to the tandem office such as is connected to terminals 836, relay 970 is not operated, the terminal engaged by the lowest brush being connected through the winding of a route relay to negative battery. Assuming that the selected trunk is a direct trunk, the call is then completed in the same manner as the above-described call to office 26 except that relay 980 is operated as soon as relay 970 operates to allow the office code impulses to be transmitted as well as the numerical digits. The operating circuit for relay 980 includes a front contact of relay 970, conductor 973 and a front contact of relay 1330. Closure of the talking circuit, meter operation and release are effected as above described.

Call to step-by-step office—Office code transmitted—Repeated charge

Assume now that the calling subscriber dials the number of the subscriber in a step-by-step office reached over direct trunks connected to terminals in the third level of the switch TS, the charge for such calls being greater than the charge for local calls. Assume further that the office code is 42, the dialing of the office code 42 being effective to set the switch TS with its brushes in engagement with the set of terminals 842. When relay 1005 releases at the end of the second digit, it closes a circuit for operating the route relay 1340, this circuit being traced from negative battery through the middle winding of relay 1340, conductor 1341, terminals and cross-connecting conductor of terminal strips 1190 and 1191, conductor A42, lowest terminal of terminal set 842, lowest brush of selector TS, conductor 694, lower back contact of relay 1005, conductor 942, lowermost back contact of relay 940, conductor 1085, back contacts of relays 1080 and 1070, conductor 1315, uppermost back contact of relay 1310, conductor 955, outer back contacts of relay 950, conductor 954, back contact of relay 750, to ground at a back contact of relay 1020. Relay 1340 locks through its upper winding and front contact, through conductor 1032, to ground at a front contact of relay 1030; connects ground to the third segment of commutator 1010; closes a circuit, through conductor 611, for operating relay 610, and connects ground to conductor 973 to operate relay 1550 of the register sender. Relay 610 having been operated and the calling subscriber not being restricted to local calls so that relay 930 is operated and locked as hereinbefore described, a circuit is closed for operating relay 1020, this circuit is traced from battery through the winding of relay 1020, conductor 747, upper front contact of vertical off-normal springs 744, conductors 746 and 957, continuity back contact of relay 950, outer upper front contact of relay 930, conductor 621, to ground at the inner lower front contact of relay 610. The operation of relay 1020 causes the return of selectors TS and AS to normal in the manner hereinbefore described. When the selector TS reaches normal, relay 950 is operated by the closing of the circuit through its winding, conductor 1003, lower front contact of relay 1000, conductor 745, upper back contact of vertical off-normal spring 744, conductors 746 and 957, continuity back contact of relay 950, upper outer front contact of relay 930, conductor 621, to ground at a front contact of relay 610. Relay 950 locks to the same ground, closes the circuit for operating relay 760 to cause the operation of selector TS to step its brushes up to the third level of its bank. When the brush of commutator 1010 engages the grounded third-level segment, relay 960 is operated and the brushes of selector TS are advanced to hunt for an idle trunk connected to terminals in this level. When an idle trunk is found, relay 600 operates. If the selected trunk is a direct trunk to a step-by-step office, the terminal engaged by the lowest brush of selector TS, for instance the lowest terminal of terminal set 832, is connected through a winding of the unassigned code relay 1060 to positive battery, thereby operating relay 970 to prepare for battery-ground impulse transmission. Since on this call it is necessary to transmit the office code digits as well as the numerical digits of the calling subscriber's number, relay 980 is operated by the energization of its lower winding in a circuit traced through a front contact of re-

lay 970 and conductor 973 to ground at a front contact of relay 1340. Relays 985, 650, 651 and 1510 are operated in the manner described on a call to office 26; and the office code and numerical digits of the called subscriber's number are transmitted over the selected trunk to the line relay of the incoming selector in the step-by-step office in which the selected trunk terminates. When all of the impulses have been transmitted in the manner hereinbefore described, relays 660 and 655 are operated and the register sender is restored to normal. The operation of relays 660 and 665 closes the supervisory connection between the repeating coil 630 and the selected trunk. When the call is answered, the operation of relay 670 closes a circuit for operating relay 900. The operation of relay 900 is ineffective to reverse the current through the windings of relay 400 of message register trunk circuit MRT because relay 1320 is not operated; but the operation of relay 900 closes a circuit for operating relay 1490 of the multiregistration control circuit MRS shown in Fig. 14. The circuit for operating relay 1490 is traced from battery through its winding, conductor 1471, a front contact of relay 1340, conductor 1343, front contact of relay 900, conductor 909, normally engaged terminal 1 and brush 1493 of the timing switch TM. The switch TM is a 44 position switch comprising a stepping magnet 1400. Each of brushes 1401, 1403 and 1405 makes successive contact with terminals numbered 1 to 22, following which each of brushes 1402, 1404 and 1406 makes successive contact with terminals numbered 23 to 44. Relay 1490 locks independent of the position of brush 1403 and connects the winding of relay 1475 to the interrupter 1496, the brush of which is connected to ground once every half second. Relay 1475 is thereupon intermittently operated to close a circuit, including the brush 1405 and terminals 1 to 5, inclusive of switch TM, for operating the stepping magnet 1400 once every half second. If the connection is released and relay 900 releases before selector TM has reached terminal 6, relay 1490 releases causing the selector TM to be restored to normal, in the manner hereinafter described. If relay 900 remains operated until selector TM has advanced to terminal 6, relay 1480 is operated by the closing of a circuit from battery through its lower winding, front contact of relay 1490, terminal 6 and brush 1401 of switch TM, to ground at its own back contact. Relay 1480 locks through its upper winding, through conductor 1035, to ground at a front contact of relay 1030. After relay 1480 has operated and before switch TM has advanced to the next position, the winding of relay 1485 is connected in series with the lower winding of relay 1480 causing the operation of relay 1485 nutil the switch TM is advanced to position 7. Relay 1485 closes a circuit, for operating the calling subscriber's message register, from battery through the front contact of relay 1485, conductor 1486, upper back contact of relay 750, conductor 534, terminal and brush 524 of selector S1, front contact of relay 504, conductor 414, lower front contact of relay 404, back contact of relay 406, back contact of relay 401, conductor 284, front contact of relay 241, brush 134, conductor 117 through the winding of message register 110 to ground. With relay 1480 operated, ground is connected to terminals 6 to 14, inclusive and 16 to 22, inclusive of arc 1495, each operation of relay 1475 after switch TM reaches position 6 being effective to operate stepping magnet 1400 to advance the brushes to position 15. When the switch TM advances to position 7, relay 1485 releases, in turn releasing the message register 110. Terminals 8, 10, 12 and 14 of the terminal arc associated with brush 1401, are connected through conductors 1407, 1408 and 1409, front contacts of relay 1340, conductors 1411, 1412 and 1413, and cross-connected terminals of terminal strips 1410 to ground so that no further operations of relay 1485 and message register 110 occur during the further advance of switch TM around to normal position. The aforementioned operation of relay 1490 also connected the winding of motor 1494 to the alternating current source 1493 to start the operation of this motor, whereby contacts 1492 are closed for one and a half seconds at intervals of 15 seconds. as soon after the switch TM enters position 15 as the timing contacts 1492 are closed, a circuit is closed from ground at the inner lower front contact of relay 1490, through contact 1492, to operate relay 1498. As soon after relay 1498 has operated as the interrupter 1496 connects ground to operate relay 1475, a circuit is closed for operating the stepping magnet 1400 from battery through its winding, through a front contact of relay 1475, brush 1405 and terminal 15, front contact of relay 1498, to ground at the lowermost front contact of relay 1480. The switch TM is thus advanced out of position 15. The switch is advanced one step by each operation of relay 1475 under control of interrupter 1496 by a circuit including brush 1405 and terminals 16 to 22, inclusive. The further advance of the switch TM is under control of the timer contact 1492. The closure of contact 1492 once every fifteen seconds and the operation of relay 1475 while relay 1498 is operated, operates the stepping magnet 1400 to advance the switch TM one position so that in a five minute period the brushes of this switch are advanced to position 44. While the switch is in position 43, a circuit is closed through brush 1402 for operating relay 1470; and relay 1470 locks under control of relays 1480 and 1030. With relays 1470 and 1498 operated, a circuit is closed through the winding of stepping magnet 1400, brush 1406 and terminal 44, front contact of relay 1470, front contact of relay 1498 to ground at a front contact of relay 1480. The switch TM has thus completed one cycle of operation. Since on the call in question the message register is to be operated once for each succeeding five minute interval during which the talking connection is maintained, the same as for the first five minute interval, the operation of relay 1470 makes no change in the advance of the switch TM on its succeeding cycles of operation. As long as relays 670 and 900 remain operated, the timing switch continues its cycles of operation to repeat the operation of message register 110 once for each five minute interval of conversation.

When the calling subscriber replaces the receiver to release the connection, relays 680 and 1030 are released to cause the return of selector TS to normal as above described. The release of relay 1030 causes the release of relays 1470, 1480 and 1340; and the release of relay 1340 causes the release of relay 1490. The release of relay 1490 closes the self-interrupting circuit of stepping magnet 1400 through brush 1403 to advance switch TM to position 23 and through brush 1402 to advance switch TM to position 43. In position 43, relay 1470 reoperates closing a circuit from ground through brush 1492 and terminal 43, inner lower front contact of relay 1470, inner upper front contact of relay 1470, through back

contacts of relays 1490 and 1480 and the interrupter contact of stepping magnet 1400 for operating stepping magnet 1400 to advance the brushes to position 44. Relay 1470 releases when the switch advances from position 43 to close a circuit for reoperating magnet 1400 to step the brushes from position 44 to normal.

Calls through tandem

Assume next that the call is one completed through the crossbar tandem office, the office code of the called number being 732. In this case the brushes of selector AS are advanced into engagement with terminal set 1132 and when relay 1186 releases at the end of the last impulse of the train created by the dialing of the third digit of the office code, relay 1350 is operated in a circuit from battery through middle winding of relay 1350, conductor 1351, terminals and cross-connecting conductor of terminal strips 1190 and 1191, conductor A732, terminal and brush 1197 of switch AS, front contact of relay 1155, segment 7 and brush of commutator 1010 of switch TS, conductor 1009, back contact of relay 1186, conductor 953, lowermost back contact of relay 950, conductor 954, back contact of relay 750 to ground at a back contact of relay 1020. Relay 1350 locks through its upper winding to conductor 1032, connects ground to the second segment of commutator 1010 since the trunks to the tandem office are located in the second level of switch TS, and connects ground to conductor 611 to operate relay 610. Relay 610 connects ground through conductor 621 and a front contact of the class of service relay 930 to conductor 956 to operate relay 1020 and thus return switches TS and AS to normal in the manner hereinbefore described. When switch TS reaches normal, relay 950 operates and locks as above described to close the circuit for operating relay 760 and thereby cause the brushes of selector TS to be stepped up to the second level and to hunt for an idle trunk to the tandem office. When an idle trunk is found relay 600 operates. The terminal engaged by the lowest brush of switch TS is connected through the winding of a route relay to negative battery. To illustrate, if the terminal set 822 is selected, and code 22 is the local code, the lowest terminal of this set is connected through conductor A22 and the cross-connecting conductor at terminal strips 1191 and 1190 through conductor 1051 through the lower winding of relay 1050 to negative battery. Therefore relays 970 and 975 are not operated and impulses will be transmitted over the seelcted trunk T22 in a loop circuit.

The operation of relay 600 closes a bridge including the winding of polarized relay 670 across the talking conductor of the selected trunk circuit, for instance trunk circuit T22, to effect the connection of an idle register sender to this trunk in the tandem office. This bridge is traced from the tip brush of selector TTS, through conductor 691, front contact of relay 610, back contacts of relays 620 and 640, conductor 641, back contact of relay 970, conductor 971, back contact of relay 665, winding of relay 670, back contact of relay 665, conductor 667, back contact of relay 975, conductor 642, back contact of relay 640, conductor 605, front contacts of relays 600 and 610, through conductor 692 to the ring brush of selector TS. The current through the winding of relay 670 is in the non-operate direction until an idle register sender in the tandem office is connected to the trunk; at which time, the current over trunk T22 is momentarily reversed to effect the momentary operation of relay 670 to indicate that the transmission of the office and numerical code may be started. The operation of relay 670 closes a circuit for operating relay 651. Relay 651 closes a circuit which is effective as soon as relay 670 releases, to hold relay 651 and operate relay 650 in series, through conductor 963, to ground at a front contact of relay 960. The operation of relay 650 short-circuits resistor 655 to operate relay 1510 and thereby starts the transmission of impulses to impulse repeating relay 640. The operation of relay 640 in response to the first impulse of the first digit of the office code, effects the operation of relay 645. The alternate operation and release of relay 640 opens and closes the bridge across the talking conductors of the trunk thereby transmitting trains of impulses over the trunk to the attached register sender in the tandem office. Being slow in releasing relay 645 remains operated while each train of impulses is being transmitted, the winding of relay 670 being short-circuited at the front contacts of relay 645 to aid the reoperation of the impulse receiving relay in the tandem office at the end of each impulse. When all of the impulses have been transmitted relays 660 and 665 are operated and the register sender RS is restored to normal as hereinbefore described.

The desired connection is completed under the control of the register sender in the tandem office and, when the call is answered, relay 670 is again operated by a reversal of the current over the conductor of trunk T22. The operation of relay 670 closes the circuit for operating relay 900, and relay 900 closes the circuit for operating relay 1490 as hereinbefore described. The operation of the multiregistration control circuit MRS is thus started to make the required initial charge, to measure off the units of time during which the talking connection is maintained and to make the required additional charge for each overtime unit. If more than one operation of the calling subscriber's message register is required during the first or succeeding charging intervals, or if the overtime periods are longer than the initial period, the terminals of terminal strips 1430 and 1440 are cross-connected to enable the desired number of operations and length of interval. Assuming two operations of the message register are required for the first interval, terminal 8 of timing switch arc 1401 is connected, through a front contact of route relay 1350, conductor 1423, and cross-connecting conductor and terminal strips 1420 to conductor 1415, thence through a back contact of relay 1470, to conductor 1414, so that relay 1485 operates when switch TM reaches position 8 of its first cycle of advance; and terminals 10, 12 and 14 are connected through front contacts of relay 1350, conductors 1421 and 1422, and cross-connected terminals of terminal strips 1420 to ground to prevent the further operation of relay 1485 during the first cycle of advance. If only one operation of the message register is required for each overtime interval, terminal 8 of arc 1401 is connected through conductors 1407 and 1423, cross-connection at terminal strips 1420 and conductor 1415, to ground at a front contact of relay 1470 after the first cycle of advance of switch TM to prevent the operation of relay 1485. If two operations of the register are required for each overtime period, the same as for the initial period, conductor 1423 is cross-connected to conductor 1414 at terminal strips 1420 instead of being cross-connected to conductor 1415. If the de-

sired initial interval is five minutes, conductors 1451, 1452 and 1453 are cross-connected to conductor 1445 so as to short circuit the contacts of relay 1475 so that the advance is controlled by relay 1498. If a shorter initial interval is desired and the same interval is required for overtime charges, terminals 25 to 28, inclusive, terminals 29 to 32, inclusive, and terminals 34 to 42, inclusive, are connected through front contacts of the operated route relay, through conductors 1451, 1452 and 1453 and cross-connected terminals of terminal strips 1450 to ground to place the advance through these groups of positions under control of relay 1475 as desired. If a shorter time is required for overtime charges than for the initial charge, conductors 1451, 1452 and 1453 are cross-connected at terminal strips 1450 to conductor 1444; so that after relay 1470 operates, the advance of switch TM through any one or more of the groups of positions may be effected under the control of relay 1475 instead of relay 1498.

If the called office code is 833, the brushes of selector AS are advanced into engagement with the terminal set 1133; and, when relay 1186 releases at the end of the last impulse of the train connected by the dialing of the third digit of the office code relay 1360 is operated in a circuit from battery through its middle winding, conductor 1361, terminals and cross-connecting conductor of terminal strips 1190 and 1191, conductor A833, terminal and brush 1198 of switch AS, front contact of relay 1155, segment 8 and brush of commutator 1010 of switch TS, thence to ground at a back contact of relay 1020 as above described. Relay 1360 locks to conductor 1032; effects the return of selectors AS and TS to normal, and effects the selection of an idle trunk to the tandem office as described above. Completion of the call and operation of the calling subscriber's message register is effected as hereinbefore described, the number of operations and length of initial and overtime charging periods being determined by the cross-connections at terminal strips 1430 and 1460.

Restricted service call

If a call is initiated at a restricted service subscriber's station, relay 930 is not operated; and if the called office code indicates that the charge is in excess of the local charge, the operation of relay 610, as above described, closes a circuit for operating relay 620. The circuit for operating relay 620 is traced from ground at the inner lower front contact of relay 610, upper winding of relay 620, conductor 622, continuity back contact of relay 950, conductors 957 and 746, front contact of off-normal springs 744 of switch TS, conductor 747, to the winding of relay 1020. Relay 1020 is marginal and does not operate in series with relay 620, thereby preventing the immediate return of switches AS and TS to normal. Relay 620 locks through its lower winding to conductor 1032. When the dialing of the office code is completed, relay 1000 operates and locks as hereinbefore described. With relays 1000 and 620 operated, a busy tone is transmitted from source 778, through conductor 779, front contact of relay 1000, conductor 623, and front contact of relay 620 in parallel with the lower winding of relay 680. Release of the line, line finder, selector and trunk circuits is effected when the calling subscriber restores the telephone instrument to normal condition in the manner above described.

Timing circuit operation and alarm

The common timing and alarm circuit TC shown in part in Fig. 10 comprises three slow-acting relays 1091, 1092 and 1093 which operate and release in a two-minute cycle whenever a starting ground is connected to conductor 724, an alarm relay 1090 the operation of which effects the operation of an alarm at the end of a desired interval of time, three slow-acting relays 1095, 1096 and 1097 which operate and release in a 24-second cycle whenever a starting ground is connected to conductor 711, and a relay 1098 which controls the connection of battery to conductor 709.

When the translating trunk circuit TT is seized, and the attached register sender connects ground through resistor 1525 to conductor 1266, the operation of relay 700 prepares a circuit for operating relay 710. As soon after relay 700 operates as relay 1098 is normal, the circuit for operating relay 710 is closed from battery through the back contact of relay 1098, conductor 709, winding of relay 710, front contact of relay 700, conductor 701, back contact of relay 665, conductor 1209, to ground at a front contact of relay 1210. Relay 710 locks independent of the timing circuit under control of relays 700, 665 and 1210 and connects ground to conductor 711 to operate start relay 1095 of the 24-second timing relays. As soon after relay 711 operates as ground is next connected to conductor 712 by the operation of relay 1097, relay 730 is operated by the energization of its lower winding. If relay 700 releases, due to the dialing of a digit by the calling subscriber or the transmission of a digit by the register sender, before relay 730 operates, it causes the release of relay 710 and a new cycle of timing is started when relay 700 reoperates. If relay 700 remains operated long enough for relay 730 to be operated, relay 730 opens the operating circuit of relay 1030 and connects retard coil 735, through conductor 736 and back contact of relay 1055, to conductor 533. When relay 1030 releases and ground is disconnected from conductor 533, the retard coil 735 discharges through conductors 533 and 413 into condenser 411, building up a high enough potential between the control grid of tube 410 and the cathode element to break down the resistance of tube 410 and cause the operation of relay 407. Relay 407 locks under control of relay 403 and closes a circuit including the calling line for operating relay 408, busy tone being thereby transmitted from source 409 to the calling station. Relay 408 connects resistor 428 across conductors 411 and 412 to again operate relays 501 and 502 when relay 504 releases as hereinafter described. When relay 404 releases, due to the disconnection of ground from conductor 413, relay 405 operates. Relay 405 closes a locking circuit through its lower winding; and relay 406 is operated by its lower winding in series with the locking winding of relay 405. The operation of relay 405 causes the release of relay 504 and operation of release magnet 513 of switch SI. The operation of relay 406 causes the release of relay 403, relay 406 being locked through its upper winding until relay 403 releases. The operation of release magnet 513 restores switch SI to normal. With relay 403 released and relay 502 operated, ground is connected to conductor 283 to hold the line finder. The release of relay 403 causes the release of relay 405; but relays 406 and 407 are locked through conductor 413 to ground at the front contact of relay 502. If the subscriber dials,

relay 408 repeats the impulses to relay 501, and selector S1 will be operated; but ground is connected through the inner upper front contact of relay 407 and lower front contact of relay 406 to conductor 421 to cause the brushes of selector S1 to be advanced to the eleventh rotary position in any selected level. When the calling subscriber hangs up, relay 408 releases. The release of relay 408 causes the release of relays 501 and 502 thereby causing the selector S1 and the line finder LF1 to be restored to normal in the manner hereinbefore described.

When a call through trunk circuit TT progresses to the point where all impulses have been transmitted by the register sender over a selected trunk and the register sender is released, the operation of relay 660 as hereinbefore described closes a connection from the winding of relay 720 through conductor 721, a front contact of relay 660, conductor 663, a back contact of relay 900, conductor 722, continuity back contact of relay 720 to conductor 723. As soon thereafter as the timing relays 1091 and 1093 are normal, relay 720 operates and locks independent of the timing circuit, under control of relays 660 and 900. Relay 720 connects ground to conductor 724 to start and/or continue the cyclic operation of relays 1091, 1092 and 1093. If relay 900 does not operate before ground is connected to conductor 725 by the operation of relay 1093, relay 730 is operated and locked to effect the release of relay 1030, breakdown of tube 410 and the further operations of the trunk circuit MRT, selector S1 and line finder LF1 above described.

What is claimed is:

1. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunks circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means effective if the call is a local call to release said translating trunk circuit and return the brushes of said first selector to normal, and means thereafter controlled by said calling subscriber's dial for connecting the calling line with a called line, said means including said first selector and one of said final selectors.

2. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, and means effective if the call is one to be routed through a trunk to another exchange for automatically operating said group selector to select an idle trunk in the group extending to said other exchange.

3. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means associated with said translating trunk circuit for registering the office code and numerical digits dialed at said calling station, means effective if the call is one to be routed through a trunk to another exchange for automatically operating said group selector to select an idle trunk in the group extending to said other exchange, and means thereupon effective to transmit trains of impulses over the selected trunk to effect the completion of the desired connection.

4. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means associated with said translating trunk circuit for registering the office code and numerical digits dialed at said calling station, means effective if the call is one to be routed through a trunk to another exchange for automatically operating said group selector to select an idle

trunk in the group extending to said other exchange, and means thereupon effective to transmit trains of impulses, corresponding to the registered numerical digits, over the selected trunk.

5. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means associated with said translating trunk circuit for registering the office code and numerical digits dialed at said calling station, means effective if the call is one to be routed through a trunk to another exchange for automatically operating said group selector to select an idle trunk in the group extending to said other exchange, and means thereupon effective to transmit trains of impulses, corresponding to the registered office code and numerical impulses, over the selected trunk.

6. In a telephone system, an exchange comprising subscribers' lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the banks of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means associated with said translating trunk circuit for registering the office code and numerical digits dialed at the calling stations, means effective if the call is one to be routed over a trunk to another exchange for automatically operating said group selector to select an idle trunk in the group leading to said other exchange, means effective if the selected trunk terminates in the called exchange to transmit trains of impulses corresponding to the registered numerical digits only, and means effective if the selected trunk is in a group through which calls to more than one other exchange are routed to transmit trains of impulses corresponding to the registered office code and numerical digits.

7. In a telephone system, an exchange comprising subscriber's lines, groups of trunks to other exchanges, subscribers' stations each including an impulse dial for use in establishing connections, first selectors, means for connecting a calling line with an idle one of said selectors, final selectors accessible to said first selectors for use in selecting called lines, translating trunk circuits connected to the bank of said first selectors, means responsive to the connection of a calling line to one of said first selectors for operating said selector to connect the calling line to an idle one of said translating trunk circuits, trunk group selectors, one for each of said translating trunk circuits, said groups of trunks connected to the banks of said trunk group selectors, means including the trunk group selector of a translating trunk circuit to which a calling line is connected operative in response to the dialing of the office code at the calling station for determining whether the call is a local call or a call to be routed through a trunk to another exchange, means associated with said translating trunk circuit for registering the office code and numerical digits dialed at said calling station, means effective if the call is one to be routed through a trunk to another exchange for automatically operating said group selector to select an idle trunk in the group extending to said other exchange, and means thereupon effective to transmit trains of impulse over the selected trunk to effect the completion of the desired connection, said impulses being transmitted in separate grounded circuits over the conductors of said trunk if the selected trunk is in a first certain one of said groups and being transmitted in a loop circuit if the selected trunk is in a second certain one of said groups.

8. In a telephone system comprising a local automatic office and a tandem automatic office, subscribers' lines in said local office, switches including first selectors for completing connections between calling and called lines in said local office, discriminating selectors connected to the banks of said first selectors, trunks between said local and tandem offices connected to the banks of said discriminating selectors, means responsive to the initiation of a call over one of said lines for connecting said line to one of said first selectors, means automatically effective in response to connection of a calling line to a first selector for operating said selector to connect the calling line with an idle one of said discriminating selectors, subscriber controlled means for operating the connected discriminating selector to select a set of terminals identifying the called office, means automatically effective if the selected set of terminals identifies the called office as being one accessible through said tandem office to restore said discriminating selector to normal and reoperate said discriminating selector to select an idle one of said trunks, and means automatically effective if the selected set of terminals identifies the called office as being said local office to release the discriminating selector and return the brushes of the first selector to which the calling line is connected to normal to render the first selector responsive to calling subscriber control.

9. In an automatic office of a multioffice telephone system in which certain offices are identified by two digit codes and other offices are identified by three digit codes, subscribers' lines and stations, each station including an impulse dial for use in controlling the establishing of de-

sired connections, switches including first selectors for completing connection between calling and called lines in said offices, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector and an auxiliary selector, groups of trunks to other offices connected to the banks of said trunk group selectors, means responsive to the initiation of a call at one of said stations for connecting the calling line to an idle one of said first selectors, means effective in response to the connection of a calling line to a first selector to automatically operate said selector to connect the calling line to an idle one of said translating trunk circuits, means in a selected translating trunk circuit responsive to the first digit dialed at the connected calling subscriber's station for advancing both the group selector and the auxiliary selector of said translating trunk circuit to a position corresponding to the digit dialed, means effective if said first digit is the first digit of a two digit office code to operate said group selector in response to the second digit dialed at the calling station to select a set of terminals corresponding to the called office code, means effective if said first digit is the first digit of a three digit office code to operate said auxiliary selector in response to the second and third digits dialed at the calling station to select a set of terminals corresponding to the called office code, means effective upon selection of a set of terminals identifying a called office other than said automatic office to restore said group and auxiliary selectors to normal and to reoperate said group selector to select an idle trunk through which the call may be completed, and means effective upon selection of a set of terminals identifying said automatic office to release said translating trunk circuit and to restore to normal the brushes of the first selector to which the calling line is connected thereby to render said first selector controllable by the dial at the calling station.

10. In an automatic office of a multioffice telephone system, subscribers' lines and stations, the stations on certain of said lines being restricted service stations, each of said stations including an impulse dial for use in controlling the establishing of desired connections, switches including first selectors for completing connections between calling and called lines in said office, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector, groups of trunks connected to the banks of said trunk group selectors, means responsive to the initiation of a call at one of said stations for connecting the calling line to an idle one of said first selectors and for automatically operating said first selector to connect the calling line to an idle one of said translating trunk circuits, means including means in said translating trunk circuit for determining and indicating whether a connected calling station is a restricted service station, means comprising the trunk group selector of a translating trunk circuit responsive to the dialing of the office code of a called subscriber's number at the connected calling station for determining whether the call is a local call or is one to be completed through a trunk in one of said groups of trunks, means effective if the call is a local call to release said translating trunk circuit and restore the brushes of the first selector to which the calling station is connected to normal thereby rendering said first selector controllable by the dial at the calling station, means effective if the call is a call other than a local call and the calling station is not a restricted service station to operate the group selector of said translating trunk circuit to select an idle trunk through which the call can be completed, and means effective if the call is other than a local call and the calling station is a restricted service station to prevent the selection of a trunk by said group selector and to transmit a busy tone to the calling station.

~~11~~. In an automatic office of a multioffice telephone system, subscribers' lines and stations of a plurality of classes, each of said stations including an impulse dial for use in controlling the establishing of desired connections, switches including first selectors for completing connections between calling and called lines in said office, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector, groups of trunks connected to the banks of said trunk group selectors, one of said groups of trunks being trunks to an operator's position, means responsive to the initiation of a call at one of said stations for connecting the calling line to an idle one of said first selectors and for automatically operating said first selector to connect the calling line to an idle one of said translating trunk circuits, means in a translating trunk circuit to which a calling line is connected for determining and indicating the class of the calling line, means comprising the trunk group selector of said translating trunk circuit responsive to the dialing of the office code of a called subscriber's number at the calling station for determining whether the call is a local call or is one to be completed through a trunk in one of said groups of trunks, means effective if the call is a local call to release said translating trunk circuit and restore the brushes of the first selector to which the calling station is connected to normal thereby rendering said first selector controllable by the dial at the calling station, means rendered effective by the selection of said group of trunks to an operator's position in response to the first digit dialed at the calling station to further operate said group selector to select an idle trunk in said group, and means effective upon selection of an idle trunk to an operator's position for indicating to the selected trunk the class of the calling station.

12. In an automatic office of a multioffice telephone system, subscribers' lines and stations, a message register for each of said lines, each of said stations including an impulse dial for use in controlling the establishing of desired connections, means including message rate trunk circuits and first selectors for completing connections between calling and called lines in said office, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector, groups of trunks to other offices connected to the banks of said group selectors, means responsive to the initiation of a call at one of said stations for connecting the calling line to an idle one of said first selectors and for automatically operating said first selector to connect the calling line to an idle one of said translating trunk circuits, means comprising the trunk group selector of a translating trunk circuit connected to a calling line responsive to the dialing of the office code of a called subscriber's number at the calling station for determining whether the call

is a local call or an interoffice call and for determining which of said groups of trunks is to be selected if the call is other than a local call, means effective if the call is a local call to release said translating trunk circuit and to restore the brushes of the first selector to which the calling line is connected to normal, means including said first selector controlled by the dial at the calling station for completing a connection with the called line, means in each of said message rate trunk circuits operative upon completion of a local call and answer of the called subscriber for operating said message register, means effective if the call is not a local call for operating said group selector to select an idle trunk in the group through which the call can be completed, and means associated with said translating trunk circuit operative upon answer of an interoffice call for controlling the operation of the message register of the calling line.

13. In an automatic office of a multioffice telephone system, subscribers' lines and stations, a message register for each of said lines, each of said stations including an impulse dial for use in controlling the establishing of desired connections, means including message rate trunk circuits and first selectors for completing connections between calling and called lines in said office, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector, groups of trunks to other offices connected to the banks of said group selectors, means responsive to the initiation of a call at one of said stations for connecting the calling line to an idle one of said first selectors and for automatically operating said first selector to connect the calling line to an idle one of said translating trunk circuits, means comprising the trunk group selector of a translating trunk circuit connected to a calling line responsive to the dialing of the office code of a called subscriber's number at the calling station for determining whether the call is a local call or an interoffice call and for determining which of said groups of trunks is to be selected if the call is other than a local call, means effective if the call is a local call to release said translating trunk circuit and to restore the brushes of the first selector to which the calling line is connected to normal, means including said first selector controlled by the dial at the calling station for completing a connection with a called line, means in each of said message rate trunk circuits operative upon completion of a local call and answer of the called subscriber for operating said message register, means effective if the call is not a local call for operating said group selector to select an idle trunk in the group through which the call can be completed, and means associated with said translating trunk circuit operative upon answer of an interoffice call for operating the message register of the calling line a desired number of times as a charge for an initial period of conversation and for reoperating the message register of the calling line a desired number of times as a charge for each overtime period of conversation.

14. In an automatic local office of a multioffice telephone system, subscribers' lines and stations, each of said stations including an impulse device for controlling the establishing of desired connections, means including first selectors for completing connections between calling and called lines in said office, translating trunk circuits connected to the banks of said first selectors, each of said translating trunk circuits comprising a trunk group selector, groups of trunks connected to the banks of said trunk group selectors, one of said groups consisting of trunks to an operator's position, another of said groups consisting of trunks to another automatic local office, another of said groups consisting of trunks to a tandem automatic office, means responsive to the initiation of a call over one of said lines for connecting the calling line to an idle one of said first selectors and for automatically operating said first selector to connect the calling line to an idle one of said translating trunk circuits, means comprising the group selector of a translating trunk circuit connected to a calling line responsive to the office code digits of a called subscriber's number dialed at the calling station for effecting the release of the translating trunk circuit and return to normal of the first selector to which the calling line is connected if the call is a local call, means comprising the group selector of a translating trunk circuit connected to a calling line responsive to the dialing of the digit zero at the calling station for selecting an idle one of said trunks to an operator's position, means comprising the group selector of a translating trunk circuit connected to a calling line responsive to the dialing of the office code digits of the number of a called subscriber in said other automatic local office for restoring and reoperating said group selector to select an idle trunk in the group to said other local office, and means comprising the group selector of a translating trunk circuit connected to a calling line responsive to the dialing of the office code digits on a call to be routed through said tandem office for restoring and reoperating said group selector to select an idle trunk in the group to said tandem office.

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